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CONTENTS

ELECTRIC RAILWAY TRACTION

A Supplement illustrating and describing developments in Electric Railway Traction is presented with each copy of this week's issue.

Trade Cycles

AS far back as 1872 there was issued a trade chart, reproduced on page 300 of this issue, remarkable in that, recording graphically the booms and depressions in this country from the beginning of the nineteenth century up till 1872, it projected the graph forward to 1945 in such a way that events in the intervening half century to date have confirmed its correctness. It indicates that years in which panics have occurred, and may be expected to occur again, run in regular repeating cycles of 16, 18 and 20 years; that years of good times run in repeating cycles of 8, 9, and 10 years; and years of hard times in 9, 7 and 11-year cycles. Thus it was shown, at the time the chart was prepared in 1872, that 1931 would be one of the worst years in this country, and 1935 a good one. It almost looks as if nature had a hand in the proceedings, so regular are the cycles of events, but the observation of natural conditions indicates the fallacy of any such supposition. A curve plotted to show the development by man of the resources of nature would be a continuously rising one, having no resemblance whatever to this up and down of boom and depression in trade—from which we conclude that the boom and depression, like the so-called "economic blizzard" is entirely man-made and avoidable. Realising this, we are saved from depression when we observe that the curve of the graph predicts a steady decline in trade after this year to a climax of panic in 1945. In congratulating the enterprising firm of Braby upon its diamond jubilee, we thank whoever had the inspiration to commemorate it by the issuing of this remarkable chart.

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Government Intervention in Industry

In analysing the negligible, and sometimes negative, effects of National Recovery legislation on American railway revenue, the *Railway Age* draws particular notice to the fall in average weekly car loadings this year compared with last. Such a decline indicates that industrial output has failed to respond to recovery schemes, and the *Railway Age* calls for an increase in production as the means of correcting the economic disorder. In 1929, it points out, industrial output and distribution were 40 per cent. higher than today, yet instead of restoring to the nation its pre-crisis consumptive power, legislators try to gain easy prestige in an age of unemployment by evolving schemes of work of no lasting benefit to those who participate or of profit to the community as a whole. Alternatively, they lose the co-operation of industrial experts by imposing over their heads conditions of service and remuneration which are impossible in the present circumstances. By failing to recognise that it is not their function to dabble in such problems themselves, but to depute their solution to qualified experts, in accordance with the electorate's desires, governments are in danger of discrediting themselves in a way which invites attack.

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The Week's Traffics

Passenger train receipts of the four group companies for the past week continued to be satisfactory, showing a total increase of £31,000, whereas merchandise receipts were £22,000 down, and coal traffics showed a net decrease of £7,000. For the year to date passenger train traffics of the four companies amount to £43,638,000, an increase of £1,111,000 or 2·61 per cent. Aggregate merchandise traffics, however, show a net decrease of £7,500, the L.M.S.R. and Great Western increases of £64,000 and £58,000 respectively being overborne by decreases of £11,000 on the L.N.E.R. and of £118,500 on the Southern. Coal class traffics for the 33 weeks show a net decrease of £266,500, the only increase in this class being one of £2,000 on the L.M.S.R.

	33rd Week				Year to date.	
	Pass., &c.	Goods. &c.	Coal, &c.	Total.	Inc. or Dec.	
	£	£	£	£	£	%
L.M.S.R. ..	+ 2,000	− 1,000	+ 2,000	+ 3,000	+ 471,000	+ 1·25
L.N.E.R. ..	+ 7,000	− 9,000	− 2,000	− 4,000	+ 89,000	+ 0·32
G.W.R. ..	+ 2,000	− 6,000	− 6,000	− 10,000	+ 141,000	+ 0·89
S.R	+ 20,000	− 6,000	− 1,000	+ 13,000	+ 136,000	+ 1·06

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Northern Ireland Traffic Increases

While the receipts of railways wholly in Northern Ireland presented an unfavourable comparison with 1934 in March, April saw increases in all classes of traffic. Passenger takings (excluding parcels, mails, and miscellaneous traffic) were £14,109 in March, and compared with £15,411 in 1934, but in April there was a gain of £4,464, to a total of £20,440. In goods traffic during April tonnage of merchandise and minerals advanced by 644 tons to 48,905, but 15,199 head of livestock compared with only 8,466 in the preceding year. Total goods receipts at £16,304 represented a gain of £417, after a decline of £3,123 in March. Railways partly in Northern Ireland showed mainly better results in both months. Passenger traffic brought in £28,937 in March and £34,839

in April, compared with £28,764 and £27,199 in the corresponding months of last year. Total goods receipts were £56,807 in March compared with £52,707, and £52,175 in April, compared with £44,644. After three months railways wholly in Northern Ireland were £360 down on passengers and £5,332 down on goods, but at the end of April recorded aggregate advances of £4,112 and £4,915 respectively under these headings.

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Travelling Post Offices in Ireland

The illustration on page 278 of last week's issue of THE RAILWAY GAZETTE of the new steel-panelled travelling post office van on the Great Southern Railways calls to mind the fact that for over 80 years the Dublin-Cork route—165½ miles—has been equipped with such facilities. The first T.P.O. in Ireland was established on January 1, 1855, between these points in connection with the acceleration of the night mail to Cork, Limerick, and other towns on the former Great Southern & Western Railway. In 1860, in connection with further accelerations, arrangements were made for sorting the mails on the steamers between Holyhead and Kingstown (now Dun Laoghaire) and T.P.O.'s were established between Dublin and Limerick, and Dublin and Belfast. Before the war there were 13 travelling post offices in Ireland. Until 1867 these vehicles, in common with those in Great Britain, were under the control of the Mail Office; between 1867 and 1875 they formed a separate branch; and in the last-named year those in Great Britain were placed under the Circulation Office (now the London Postal Service) while those in Ireland came under the Controller of the Dublin Sorting Office. Naturally this arrangement was modified with the establishment of the Irish Free State in June, 1922, and the appointment of the I.F.S. Minister for Posts and Telegraphs.

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Railway Returns for 1934

In the returns of British railways for 1934 recently published by the Ministry of Transport the figures for London Transport railways are excluded from the aggregated totals given in the financial and statistical tables, except in respect of electrical working. The necessary adjustments have also been made so as to make a correct comparison with previous years. It is noted in the general report printed with the returns that a company entitled Railway Air Services Limited was incorporated on March 21, 1934, and that particulars relating to the air services operated by the company on behalf of the railway companies are included, together with particulars of the service operated by Spartan Air Lines Limited by arrangement with the Southern Railway Company. Gross receipts from railway working amounted in 1934 to £155,578,960, of which £151,144,085 (against £149,642,627 in 1933) were earned by the four group railways. Net receipts from railway working amounted to £28,795,942, of which £28,227,475 were contributed by the four companies. Among the joint lines net receipts were earned by the G.C. & Mid., G.W. & G.C., Manchester South Junction & Altrincham, Met. & G.C., M. & G.N., South Yorks., and Great Central H. & B. & Mid. Losses on working were, however, sustained by the Cheshire Lines, G.C. & N.S., L.M.S. & G.W., Norfolk & Suffolk, and Somerset & Dorset. From ordinary third class passengers on all railways except London Transport the receipts in 1934 were £37,667,897, an increase of £855,907. First class ordinary receipts improved from £3,043,936 to £3,082,212, and the total first class receipts (including season tickets) amounted to £4,698,378, representing 9 per cent. of passenger receipts.

Travel Propaganda for Italy

Italy makes use of many media to attract tourists from abroad, the most recent of which is the new establishment of the Compagnia Italiana Turismo in Regent Street (illustrated on page 314). Broadcast talks, practical as well as descriptive, are featured from the principal wireless stations, and the Italian State Railways, in collaboration with the State Travel Department, publish a monthly illustrated tourist review entitled *Travel in Italy*, the current issue of which has recently appeared in even more attractive style than heretofore. Included therewith is a bulletin of tourist news in which the energy and, to an even greater degree, the originality of the State Railway system is exemplified. The benignant eye with which Il Duce regards Young Italy's adventures in romance has already been revealed by the issue of cheap returns to Rome for honeymoon couples. This facility was extended to foreign newlyweds, and the latest concession is that those who avail themselves of it earn the right to repeat the journey at the same discount of 70 per cent. on the occasion of their Silver or Golden Weddings. We should be wrong to ask such delicacy of invention from the passenger managers of our austere northern latitudes, but in general principle the efforts of Italy to build up a steady tourist traffic are worthy of careful study.

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The Baltimore & Ohio Report

The researches and recommendations of Mr. Joseph B. Eastman, Federal Co-ordinator of Transport in the U.S.A., are favourably commented upon in the report of the Baltimore & Ohio Railroad Company for 1934, particularly in respect of his insistence upon the necessity of legislation to regulate air and motor carriers if the country is to enjoy a healthy and adequate transport system. The railway company's operating revenues increased by 2·84 per cent. in 1934 over 1933, but the company suffered from the prevailing disability to restrict expenditure to anything like a proportionate advance. An increase in operating expenditure of $8,968,084 to $99,337,784 represented 9·92 per cent. Partial restoration of wages as from July 1, 1934, was a contributory item, but the report makes special mention of the higher cost of locomotive fuel largely due to code regulations under the N.I.R.A. The additional outlay involved under this head amounted to $2,395,789. Net revenue from railway operations decreased by 12·6 per cent., and after deduction of various charges left a net operating income of $23,677,939. There was a net deficit on the year of $3,825,752. The report concludes with the remark that the company had 44,170 shareholders at the end of 1934, and requests their individual co-operation in soliciting business for the railway.

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Accidents to Railway Servants

The latest volume of railway accident reports is for the three months ended December 31, 1934. It contains 37 reports by the assistant inspecting officers on the more serious accidents to railway servants, of which 20 were fatal cases; in one of the latter three men were killed. The accidents were distributed among the various companies as follows, the number of fatal cases being added in brackets: G.W.R. 2 (1 involving 3 deaths); L.N.E.R. 15 (7); L.M.S.R. 11 (5); L.M.S.R. and S.R. Joint 1 (1); L.P.T.B. 2 (2); Port of Bristol Authority 2; Southern 4 (4); In six cases, causing eight deaths, the men were employed in the permanent way department, whilst in another two instances, they were signal linesmen, both employed by the L.P.T.B. The remaining 12 were one each from

the ranks of porter, passed fireman, wagon examiner, stationmaster, lad porter, tube cleaner, carriage lifter, goods guard, mason's labourer, shunter, and signalman, and a brakesman employed by a private firm. Nine of the 20 fatal accidents were ascribed to want of care; 8 to misadventure; 1 to an error of judgment, and 1 to an error by a look-out man. The three men killed in one accident were considered to have been guilty of a breach of rule 234 (a), requiring them, when a train is approaching, to move clear at once of all lines unless they can see that they are in a position of safety. The judgment as to want of care was modified in two cases to " momentary want of care " and " thoughtlessness." In one case it was want of care on the part of a fellow servant, a driver, when working over a facing road during an obstruction, omitting to " pop " his whistle in accordance with rule 204 and failing to keep a proper look-out.

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The Oxford and Aylesbury Tramroad to be Closed

The long-anticipated decision to close the 6½-mile Brill branch of the Metropolitan Line has now been officially confirmed with the announcement of the Metropolitan and Great Central Joint Committee that on and from December 1 next the railway between Quainton Road and Brill and the stations on this line will be closed to all traffic. The stations concerned are Waddesdon Road, Westcott, Wotton, Wood Siding, and Brill. Traffic hitherto handled at these stations will, in future, be dealt with at adjoining stations of the G.W.R. and L.N.E.R. The line was opened in 1872 largely through the instrumentality of the then Duke of Buckingham, who paid the whole cost of construction, supplied free such required land as he owned, and leased the remainder. Until 1894 it was known as the Wotton Tramway, but then the title the Oxford and Aylesbury Tramroad was adopted at a time when plans were being prepared for an extension to Oxford. This was not built, but the existing line was reconstructed, and the present permanent way laid—much of it is of flat-bottom rails spiked direct to the sleepers, but on chaired sections chairs may still be seen bearing the name of Krupp of Essen. The line was rented by the Metropolitan Railway as from December 1, 1899, and the Met. and G.C. Joint Committee assumed responsibility on April 2, 1906.

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Enginemen's Conference

On Sunday, August 11, the first conference of the Federation of Enginemen's Mutual Improvement Classes was held at Bristol, and discussions hinged upon the advancement of technical efficiency among enginemen, which is the aim of the federation. The conservatism of enginemen is well known, and it is now more important than ever that they should be kept abreast of developments in the steam locomotive. Until the general introduction of rapidly opening and closing valves and means to minimise back pressure and to assure boiler pressure in the steam chest, the driving of the average locomotive did not call for very great skill. Now, however, the best results can be obtained only by driving a locomotive very much as a motorcar is driven, where the admission of petrol is continually varied according to changing of road conditions. Similarly the admission of steam to the cylinders of a modern express engine, hauling a heavy load on a fast booking, requires skilful variation by means of the cut-off gear, the regulator being kept wide open the whole time the engine is working. Recently some striking instances of variations in driving practice have come to our notice. On one of the very latest and most carefully designed locomotives in the country, one driver kept his regulator only partially opened and worked on a comparatively long cut-off. On another occasion, with a comparable load on the same road, another driver opened his regulator wide and worked on short cut-offs. In both instances the train was worked punctually, but it is computed that on the run where long cut-offs and a small regulator opening were used the fireman had to shovel about 12 per cent. more coal. Any such mutual improvement classes as these, of which the first conference has just been held, therefore deserve not merely sympathy but active support by the railway companies.

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A Unique Cylinder Casting

There has recently been produced in America a one-piece locomotive cylinder casting of medium-carbon high-tensile steel. The casting weighs about 10¾ (long) tons finished, or approximately 20 per cent. less than a cast-iron cylinder of equivalent proportions. It combines two cylinders, the valve chambers, smokebox saddle, steam pipe connections, rear cylinder covers, guide brackets, and a frame bracing, and is thoroughly annealed after being cast to ensure freedom from internal stresses. One of the outstanding features of the casting is that the exhaust passage walls are independent of the structural walls which carry the stresses from the cylinders to the main locomotive frames. This form of construction minimises the possibility of casting failures in the zone where they usually occur, namely, on a line between the cylinder and saddle arc centres. The removal of these stresses leaves the walls free to expand or contract under extreme temperature variations and tends to prevent the development of cracked walls, with resultant steam leakage. The provision of integral rear cylinder covers eliminates the possibility of leaks such as frequently occur with the conventional, bolted, type of cover, due to the stretching of bolts under the heavy thrusts of the crossheads on the guides. The importance of this is emphasised by the high cost of repairing such defects, which in many cases ranks almost as a major operation.

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Roller Bearing Locomotive's Fine Performance

What was formerly known as the Timken locomotive, because of its equipment throughout with roller bearings of that manufacture, completed 89,000 miles on twelve of the leading American railways after its construction in 1931. In 1932 the engine was purchased by the Northern Pacific Railway and placed in regular fast passenger service, and after a total mileage of over 280,000, up to October, 1934, it had its first general shopping for repair to the boiler and machinery. All roller bearings on the engine truck, coupled and trailing wheels were removed for inspection, and the Timken assemblies were found to be in excellent condition and were returned to service with, practically speaking, no attention. The locomotive gave a good account of itself in preliminary freight service tests on the Northern Pacific, during which a total of 7,093,662 gross ton-miles were handled at an average rate of 53,670 gross ton-miles per train-hour. The average speed was 28 m.p.h. and the coal consumption 92·35 lb. per 1,000 gross ton-miles, with an average evaporation of 5·07 lb. In passenger service the locomotive is now used between Seattle and Missoula, a distance of 656 miles formerly comprising five engine districts, and including gradients of 1 in 46 on which the engine can handle nine cars. A test performance chart showed that the ratio of drawbar pull at the tender to i.h.p. in the cylinders was 90 per cent. at all speeds up to 40 m.p.h., and at higher speeds decreased gradually.

Railways of the U.S.A. in 1933

THE statistics of Railways in the United States published by the Interstate Commerce Commission form a compilation invaluable as a work of reference. Their compilation is, however, bound to take time owing to the immense amount of material to be handled and the latest complete figures available are for the year 1933. A map is inserted showing the three main districts, eastern, southern, and western into which the railways are divided for statistical purposes. The eastern district is bounded on the west by the northern and the western shore of Lake Michigan to Chicago, thence to East St. Louis and down the Mississippi to the mouth of the Ohio; on the south by the Ohio from its mouth to Parkersburg, W.Va., thence by a line to the south-western corner of Maryland, thence by the Potomac River to its mouth. The southern district is bounded on the north by the eastern district and on the west by the Mississippi. Far the largest in area is the western district which includes the rest of the country except Alaska and the island possessions. In the districts are embraced eight territorial regions, of which three, namely, New England, Great Lakes, and Central Eastern are in the eastern district; two, the Pocahontas and the Southern, in the southern district; and three, the North Western, Central Western, and South Western in the western district.

The total length of the steam railways in the United States on December 31, 1933, was 245,703 route miles, of which 57,963 were in the eastern district, 49,012 in the southern, and 138,728 in the western. Track miles totalled 404,908 (including 2,770 in Canada), of which 128,132 were in the eastern district, 74,001 in the southern, and 202,775 in the western. Abandonment of lines has been proceeding far more rapidly than new construction from 1931 onwards, and in 1933 the length of lines abandoned was 2,016 miles as against only 122 constructed. Of the total net decrease in length, 900 miles or 47·6 per cent. occurred in States west of the Mississippi. Operating companies are classified for statistical purposes on the basis of their annual operating revenues. Class 1 above $1,000,000; Class 2, from $100,000 to $1,000,000; Class 3, below $100,000. As a result of the growth of traffic and consolidations, there has been a gradual movement from the two lower classes into Class 1. The electrified mileage operated by Class 1 railways at the end of 1933 was 2,399 miles, of which 1,283 were in the eastern district, 265 in the southern, and 851 in the western. Track-miles operated electrically were 3,563 in the eastern district, 661 in the southern, and 1,238 in the western.

Operating revenues of Class 1 railways in 1933 amounted to $3,095,403,904, a decline of $31,356,250 or 1 per cent. in comparison with 1932. On the other hand, in the operating expenses of $2,249,231,779 there was a reduction of $154,213,116 or 6·42 per cent., resulting in a net revenue from railway operations of $846,172,125, which was $122,856,866 higher than in 1932. Net railway operating income improved from $326,298,008 to $474,295,613. The accompanying table shows the dividends per cent. paid by some of the more important companies on their common stocks in 1933 or 1932:—

	1933	1932
Atchison, Topeka and Santa Fe	Nil	1
Chesapeake & Ohio	10·60	10
Chicago, Burlington & Quincy	3	3
Norfolk & Western	10	9
Pennsylvania	1	1
Reading	2	2
Union Pacific	6	7
Virginian	Nil	3

The Atchison paid 4·80 per cent. and the Virginian 6 per cent. on their respective preferred stocks in 1933. The New York Central, which paid 4 per cent. on its common stock in 1931, has paid nothing since; and the New York, New Haven & Hartford, though it paid 4 per cent. on its common stock in 1931 and 1¾ per cent. on its preferred stock in 1932, paid nothing on either stock in 1933. The last dividend paid by the Boston & Maine on its common stock was 1 per cent. in 1931.

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Educational Facilities for Railwaymen

DURING the forthcoming autumn and winter evenings there will again be abundant opportunities for railwaymen to follow courses of study designed to increase their efficiency. Men of all grades take advantage of these educational facilities, probably the most popular of which are the courses of training in signalling and the safe working of railways which are organised by the railway companies. At a number of the centres of instruction models of an up-to-date signalling installation are used for demonstration purposes, while correspondence courses are also arranged for those employees who cannot conveniently attend one of the centres. The companies also arrange classes where the staff may study such important subjects as station accountancy, station working, and the principles of railway rates. Examinations are held at the conclusion of these courses and there is keen competition for the proficiency certificates which are awarded.

Further, the four main line railways provide facilities for a number of their staff to attend lectures at the London School of Economics. A special advisory committee has been created, representative of the railway companies and the school authorities, for the purpose of arranging the best curriculum for railway students. The courses, in which examinations are held, cover economics, railway law, railway statistics, commercial and operating railway economics, railway and commercial geography, economics of road transport, and accounting. Similar arrangements exist with other important educational authorities in provincial cities and towns. For permanent-way men facilities are provided at various places for attending classes of practical instruction in the elementary theory of permanent way and the best methods of permanent way maintenance. Many lecture and debating societies have been formed with the assistance of the companies, where lectures and discussions are held primarily on matters appertaining to various phases of transportation. In many districts, too, mutual improvement classes are organised by the men themselves and much practical knowledge is gained from the lectures of experts, often illustrated by lantern slides. Through the medium of the Railway Students' Association also, members of the staff can attend lectures by eminent men on railway and cognate matters, and join in the subsequent discussions, while visits are frequently organised by this body for inspecting the latest railway appliances and procedure.

In addition, the railway companies are closely associated with the work of the Institute of Transport. Special opportunities are afforded its members, graduates, and students for increasing their knowledge of transport in its widest aspects by means of lectures, congresses, discussions, &c., arranged by the institute both in London and at various centres in the provinces, which are attended by the leading members of the transport industry. The railway companies, in common with other transport organisations, assist the work of the institute by providing special awards. These comments would be incomplete without reference to the very large number of classes of instruction in first aid and ambulance work which are organised by the companies throughout their systems under the supervision of

doctors. Interest in these classes is maintained by the issue of proficiency awards and by periodical inter-district and inter-railway competitions.

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Mile-a-Minute Trains

IT is welcome news that further acceleration of train service will figure in the winter timetables of the London Midland & Scottish Railway. For the first time on record the schedules between Euston and Birmingham will be cut below the two-hour limit at which they have been fixed for so many years past. After the successful experimental runs with the "5X" class three-cylinder 4-6-0 locomotives on these trains during the course of last year, some curtailment of these times was confidently to be expected, and the only surprise, perhaps, is that on some of the lighter trains, which are so well within the tractive capacity of the locomotives, no greater cut in time than 5 min. has taken place. The result is that four down and three up expresses will cover the 112·9 miles between Euston and Birmingham, with one intermediate stop in each case, in 115 min., involving start-to-stop times of 92 min. over the 94 miles between Euston and Coventry, 104 min. for the 107·5 miles from Willesden to Birmingham, and, in the case of the 6.20 p.m. from Birmingham to London, which will make three intermediate stops within an overall time of 2 hr., exactly one hour for the 65·1 miles from Rugby to Watford. This will now be the fastest booked run on the L.M.S.R.

Elsewhere several runs at over 60 m.p.h. from start-to-stop are introduced, as, for example, from Luton to St. Pancras, 30·2 miles of mainly falling grades, to be covered in the even half-hour, and certain runs from Cheltenham to the service stop at Bromsgrove (for the attachment of the Lickey incline banking engine), which do not figure in the public timetables, and which will be covered at a shade over a mile a minute. But these accelerations have been secured merely by adjustment of intermediate times, and have had no effect on the overall times of the trains concerned, so that it is difficult in the latter case to trace any measurable public benefit that has been conferred as a result of the acceleration. Indeed, two of the up Manchester trains so accelerated to make a run of 30 min. from Luton to St. Pancras are both 3 min. slower than previously on their journeys from Leicester to London, so that what is gained on the ultimate stage is more than lost on the penultimate. The only actual gains in journey time are the 5 min. in the case of the eight up trains on the Birmingham service, and 5 min. by the up Lancastrian express, which will now make the run of 145·9 miles from Stoke-on-Trent to Euston in 145 instead of 150 min.

The Blackpool and Fylde Coast express, at 5.10 p.m. from Euston, conveying to Wigan the through East Lancashire coaches which, prior to this summer, ran on the 6 p.m. down Lancastrian, is retained in the timetable, and this permanent improvement of the East Lancashire service will be welcomed by business men travelling to Blackburn, Burnley and Colne. As an offset to this—or perhaps because Scotland seems to have been completely neglected by the speeding-up influence—the deceleration by 10 min. of the midday Glasgow express from St. Pancras still persists. And, talking of Scotland, the journey to the Highlands from London is still a good deal slower than it was 25 years ago. Much, indeed, has yet to be done in the way of general timetable improvement, before any condition approaching the ideal can be said to have been reached; and a few additional mile-a-minute runs, welcome, though they touch only the fringe of the major problem of timetable reorganisation.

Peak Period Problems

THE railways are once again faced with the recurring problems associated with the mass movement of holidaymakers. In fact, the greater number of people travelling this year renders the position more difficult than ever. On Saturdays in August most trains leave the London termini filled to capacity, often with numbers standing in the corridors, and the resultant complaints of overcrowding tend to bring railways into disfavour. Further criticism arises from the absence of dining facilities on certain of the duplicate portions of restaurant car trains, causing many travellers to find at the last moment that they must face long journeys without food. It is admitted that for every dissatisfied passenger there are thousands who have no cause for complaint, but the human weakness of making more of a grievance than a satisfaction causes some very unkind letters to appear in the press from time to time. The irony of the situation for the railways lies in the fact that, eager as they are for additional business, the concentration of traffic at peak periods forbids the maintenance of their normal standards of comfort and service. Expenditure on rolling stock which would be required only for three months of the year is obviously not a commercial proposition, and even if such extra accommodation was available, the intensive occupation of lines at holiday week-ends would make it impossible to find a path for more trains.

The position has been further complicated by the issue of cheap tickets allowing travel on any day and by any train, whereas under the old excursion arrangements passengers were required to travel by specified trains, the majority of which were run on Fridays. Some further slight concession to Friday, and possibly Sunday, might outweigh the average traveller's predisposition to start his holiday on a Saturday, thus spreading the outward movement over three days instead of compressing it into one. This would, in effect, be an extension of the existing L.N.E.R.-L.M.S.R. specially reduced fares for night travel to specified stations. Another partial solution might be found in national propaganda for earlier holidays, thus reducing the pressure in August and September. Thousands of people, however, are obliged by the school holidays to adhere to the latter months, and until the educational authorities can be convinced of the mutual advantages of spreading the summer vacations over a longer period it is not possible to anticipate much relief in this direction. In any case, the latter solution would entail years of propaganda, whereas the former lies in the hands of the railways and could be introduced at their own discretion.

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Performance Prediction at High Speeds

IF we approach a new manufacturing proposition, involving novelties of construction and hitherto unused materials, with an existing equipment of tools and appliances we are likely to entertain misleading views as to the practicability or otherwise of proceeding with it on a commercial scale. The same risk is taken when we investigate with the help of old formulæ and rules the probable effects of some revolutionary change in the design or operation of machines. In an article on page 303 of this issue an investigation is made into the effect of increased speed on locomotive haulage capacity and fuel consumption, but as it is made on strictly conventional lines—lines which were laid down some years ago on a basis of somewhat inadequate experimental work carried out at relatively low speeds—the computations cannot be taken as anything like exact. Nevertheless rough calculations, provided that they do not rest on funda-

mental error, often point to results which more accurate estimates serve in a broad way to confirm, and, where the number of variables entering into a problem is very great, it is hardly possible to discuss it at all without resort to symbols. An attempt to deal with such a problem in words would result in an exposition scarcely less mystifying than the documents published for our information by the income tax authorities.

The findings of our contributor are likely to need some correction for several reasons, and probably the most serious objection to his method of working is his adoption in these more enlightened days of a train resistance formula giving pounds per ton as a parabolic function of the speed. The component due to air resistance, if expressed in pounds per ton of train weight, is known to be less at any given speed for a long train than for a short train, and this means that the coefficient of the V^2 term is not in reality a constant but a function of the train weight. If therefore we insist on using the old parabolic formula for trains of widely different weights we ought to treat this coefficient as a variable and determine the law of its variation. The research work entailed is both difficult and expensive, since experiments to determine the resistance of full-size trains at high speeds are practically impossible to perform, while wind tunnel tests on models give results which are far from being in any simple relation to those wanted for the full-size train. Useful work has, however, been accomplished and very gradually the foundation is being laid for a more rational method of computing tractive requirements at high speeds. But when the wide variation in carriage weights and shapes is considered it will become at once apparent that no simple universal formula for train resistance is ever likely to be offered on good authority. Investigations which are now in progress may provide formulæ for different types of rolling stock when made up into trains of different lengths and with different kinds of locomotive, but comprehensiveness seems out of the question.

At some future date we hope to assemble the figures and curves which have come to hand and indicate how they may be used as a guide in calculations of the type undertaken by our contributor. Such calculations are of particular interest at the present time, but in the existing state of our knowledge the investigations could with great advantage take the form of further practical tests with experimental trains built and rebuilt to yield a good high speed performance. Though many quantities are admittedly difficult or impossible to measure with such trains, there can be no difficulty where the ultimately important ones which affect costs and earning capacity are concerned. We are confident that, in the end, the Germans with their Flying Hamburgers, the French with their Bugattis, and the Americans with the Zephyrs, must become better acquainted with the economic possibilities of high speeds on railways than those of their contemporaries who are content with mathematical deductions from more elementary experiments. It can only be regretted that more information of the kind sought abroad is not being gained at first hand in this country where many of the railways are comparatively straight and easily graded, and where therefore a great many opportunities for speedier running remain to be exploited.

LETTERS TO THE EDITOR

(*The Editor is not responsible for the opinions of correspondents*)

Railway Transit Corridors

Westminster, S.W.1.
August 21

To the Editor of The Railway Gazette

Sir,—With reference to the editorial note on railway transit corridors which you published in your issue of July 26, the following notes on similar arrangements which occur with the main trains from Western Europe to Istanbul, may be of interest.

On the main line traversed by the Simplon-Orient Express, Svilengrad is the last Bulgarian station on the journey towards Istanbul. The train then enters a section of Greece, some 15 miles long; the next stage is the station of Adrianople, in Turkey. After leaving Adrianople, the train re-enters Greece for a further distance of about 15 miles, stopping at Pithion (more usually known by its Turkish name of Kuleli Burgas), the junction for the line to Dedeagatch, Salonika, and Athens. The train then enters Turkey finally.

Some time ago I was travelling on the Direct Orient Express, once known as the "Conventionnell," which stops at all the stations in those parts, serving as the "train omnibus." Greek soldiers were stationed at the doors at the ends of the coaches so as to prevent unauthorised persons leaving the train while in Greek territory. There was, of course, no need to have a Greek visa, and no Greek passport or customs examination for passengers through to Turkey.

Another similar corridor, although not traversed by trains of such importance, is on the route used by certain express trains from Austria to Italy. Rosenbach is the last Austrian station and the trains run *via* Jesenice (junction for Ljubliana) and Bled Jezero in Jugoslavia to Piedicolle, the Italian frontier station. The length of the journey in Jugoslavia is some 15 miles, and there again through passengers do not require visas nor have their passports or luggage examined, provided, of course, that they do not alight from the train.

Yours faithfully,
A. B.

A New Field for Acceleration

Woldingham, Surrey,
August 16

To the Editor of The Railway Gazette

Sir,—May I, though speaking from a less extensive experience than Mr. R. E. Charlewood, support his plea for more enterprising schedules for new trains, and give an instance? He quotes, with a measure of approval, the Great Western Railway's new 10.15 a.m. express from Paddington to Oxford in 65 min. for the 63·4 miles. The former quickest schedule of 70 min. has been in force since 1910, and five min. gain in 25 years is not very striking. I recently made a first trip by the new train, with one of the earlier four-cylinder engines and eight coaches, 242 tons tare and about 255 tons loaded. Under quite easy steam, we were running at 67 m.p.h. by Southall (11 min. 7 sec. from Paddington) and 74½ by West Drayton. Here the engine had to be eased for the rest of the journey, but we were through Slough in 18 min. 57 sec. (18½ miles), Reading in 34 min. 28 sec. (36 miles), and Didcot E. Junction in 49 min. 15 sec. (52¾ miles), and stopped at Oxford in 60 min. 47 sec. from London. With an almost level road throughout, and an easier approach to Oxford than to Paddington, is there not a clear case for a 60 minutes schedule in the down direction as well as in the up?

Similar experiences with other trains could be cited, but this will serve to illustrate the point that there is a very large potentiality for increased speed in express train schedules, of which far less than full use is being made.

Yours faithfully,
HUMPHREY BAKER

PUBLICATIONS RECEIVED

Guide to Current Official Statistics, Vol. XIII. Permanent Consultative Committee on Official Statistics. London: H.M. Stationery Office. 9¾ in. × 6 in. 350 pp. Price 1s.—Much of the work entailed in the publication of official statistics would be wasted were it not for this annual guide to their scope and subjects. The average enquirer cannot keep pace with all the works awaiting consultation, and without a directory such as this he misses the advantage of the research and analysis constantly in progress for the benefit of public administration and private enterprise. The book is, however, far more than a catalogue of titles, being arranged to show the method and exhaustiveness of treatment accorded in the reports, returns, and other documents to which the user is referred. Publications are listed both alphabetically under subjects, and, with their prices, under titles and issuing departments. An explanatory introduction assists in the use of the guide to the fullest advantage. This directory of accumulated experience is an indispensable companion to all concerned with the administration of industrial or other undertakings.

Boletín de Obras Públicas de la República Argentina. (Journal of Public Works in the Argentine Republic.) No. 15, 1935. Buenos Aires: Ministry of Public Works. 10¾ in. × 7¼ in. 456 pp. No price stated.—This volume contains many interesting articles on public works carried out in various parts of the Argentine Republic, but the principal item of interest for readers of THE RAILWAY GAZETTE is the article by Señor Eduardo Schmidt on the revision of the railway law in that country. The substance of this is as follows: The present position of railways in Argentina is a matter of grave concern and has already been the subject of extensive official enquiry. A commission appointed to deal with it has recommended a radical alteration to the existing law governing the construction and working of railways. This law was framed in 1891 and came into effect about three years later. With some modifications, and supplemented by certain decrees, it still forms the basis of railway legislation, a fact which sufficiently emphasises the anachronism of the existing legal position. Forty years ago nobody thought of electric traction in South America, of bulk transport, high speeds, restaurant cars, and other refinements of travel. Not only traffic conditions but working conditions have altered out of all recognition in the interim. Consequently, the appointment of the commission in 1935 was welcomed in many quarters. It was ordered to "investigate the question of railway legislation and make recommendations."

Several "crises" have occurred in Argentina railway history, notably in 1890, the so-called "costs of working crisis" and, in 1914 and onwards, the "loss of traffic crisis." The present one is in many respects one of the gravest known, and for this the archaic state of the law is in great measure responsible. Road transport has sprung up unfettered and unregulated, while the railways have remained with their hands tied in all manner of ways. Curiously enough, the question was studied and reported on 20 years ago by an engineer named Nogués, in connection with a law prepared by a Dr. Saavedra Lamas. This report is still worth careful consideration. The reforms most urgently required are those which will remove out-of-date restrictions on railway enterprise, classify main and secondary lines in a more rational manner, and also regulate more effectively the user of wagons and demurrage charges, and through working with neighbouring states and the responsibilities attaching thereto. On the secondary lines unnecessary regulations concerning signalling, fencing in of tracks, the use of halts and railcars, and other items should be considerably modified to allow of cheaper working. Hours of labour also need more reasonable regulation than now obtains. At the same time, the railways should be able to own and run motor vehicles and co-operate with other transport undertakings. The Argentine railways were constructed to open up the country and they have rendered great national services by so doing, services which call for an equitable return, impossible under legislation no longer adapted to modern conditions. Given sensible reform in this respect, the railways and the State alike cannot fail to benefit, whereas without it, a great injustice will be done to the proprietors of undertakings which cannot be, under any circumstances, dispensed with.

Die Entwicklung der Schienenstossschweissung und das Studium der geschweissten Schienenstossverbindungen. (The Development of Rail-Joint Welding and the Study of Welded Rail Joints.) By D. Csilléry. 1935. Brunswick: Friedr. Vieweg & Sohn A.G. 11¾ in. by 8¼ in. 25 pp.; 27 ff. Price not stated.—This publication is a reprint of a serial article from recent issues of *Die Elektroschweissung*, in which the author outlines the development of rail welding with special reference to Hungarian conditions and practice. The economic situation of the country makes it specially desirable to use a method which does not require imported materials or apparatus. From this standpoint, electric arc welding offers advantages. The Katona method s recommended, viz., filling a prepared V between the rail heads with soft weld metal nearly to the top, finishing with a layer of wear-resisting alloy, and then welding the longitudinal edges of a hot plate placed beneath and bent over the tops of the flanges.

Comparisons are given between the weld-penetration, metallographic structure, joint stiffness, impact test, fatigue, hardness, wear, and internal-stress conditions with Thermit and arc-welded joints, and it is concluded that arc welding is able to compete effectively, both technically and economically. The concluding section of the report gives comparative statistics from service, and describes the long-rail construction (100 m. or 328 ft. between expansion joints) used by the Budapest Hauptstädtische Verkehrs A.G. and Lokalbahnen A.G. The capital cost of the long-rail construction being practically the same as that of normal construction, the smoother riding and lower cost of track and rolling-stock maintenance constitute a powerful argument in favour of welded joints.

Modern Buildings.—This publication of the British Steelwork Association, Artillery House, Artillery Row, S.W.1, has as its sub-title "The Financial Aspect," and deals with the economies effected by the use of steel framework for multiple storey buildings. Steel construction is advocated as a safeguard against obsolescence owing to the ease with which buildings can be adapted to meet changing conditions, a factor of increasing importance at the present time. It is consequently a safeguard to investment in property. Hardly less convincing than these economic arguments are the numerous illustrations of handsome examples of modern architecture.

Copper Data.—The Copper Development Association, Thames House, Millbank, S.W.1, has issued another volume in its useful series of engineers' note books. The latest addition deals with copper, and collects into a handy pocket size all the general data that the user of the metal is likely to need. The contents include chapters on copper properties, treatment and working, commercial grades and applications, and an appendix showing the relative trends of certain metal prices between 1924 and 1934, British Standard Specifications, and weights of copper plates, sheets, and circles. A full index adds a further touch of practical value to this useful compilation of data and advice.

Port of Vancouver.—The report of the Vancouver Harbour Commissioners for 1934 is a handsome and well-illustrated production of 74 pages on art paper, with one folding map. Comprised in the volume are the reports of the Harbour Master, General Superintendent, and Chief Engineer, which together present a very complete survey of activity at the port during the period under review. Statistical summaries of the year's operations are preceded by notes on the transport and other facilities available. A new air service now operates to and from the city, connecting with U.S.A. Pacific coast and transcontinental routes at Seattle. This addition makes a total of four companies serving the civic airport and seaplane harbour.

THE SCRAP HEAP

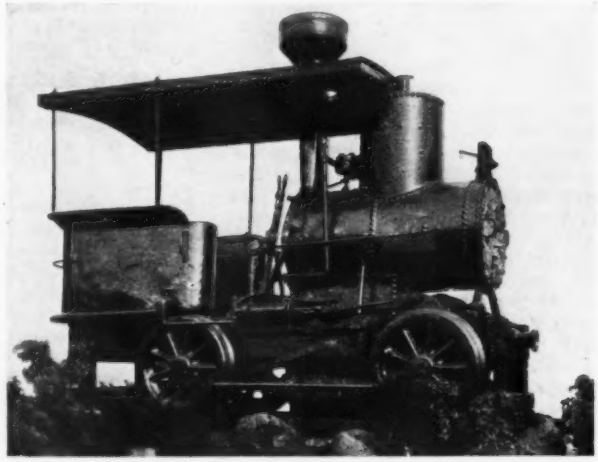
201 YEARS AGO

"London Evening Post,"
August 31, 1734

"This is to acquaint all gentlemen travellers and others that the Bear Inn, Wantage, Berks (lately in the occupation of John Gilbert) is now kept by John Frozley who for many years was cook at the Half Moon Tavern, Cheapside, London, who will take the utmost care to accommodate all his friends and customers after the best manner."

GREAT BRITAIN IN EAST PRUSSIA

"Tenant manager sought for restaurant, with living quarters adjoining, at the railway station of Great Britain." So ran a recent advertisement in a German newspaper. The Great Britain mentioned is a small village in East Prussia with a population of 220. A neighbouring hamlet called Little Britain has only 30 inhabitants. The application list is, however, already closed, and September 1 will see the proud tenant of the Great Britain railway station restaurant installed.



The first locomotive on the Pacific Coast, which is now preserved at the Union railway station, Portland, Oregon. It was named the "Oregon Pony" and in 1862–3 worked passenger and freight trains on the south bank of the Columbia river between Bonneville and Cascade Locks, Oregon

ADVERTISING FOR PROSPERITY

There are still certain people who have a predilection in favour of having their virtues hidden on a shelf at the back of the shop rather than displayed prominently in the front window. Scotsmen have blazed the trail in advertising by the toast they have proposed for centuries. "Here's tae us. Wha's like us? Damn few."—*Sir Robert Horne, speaking at the Advertising Association at Torquay.*

BRITISH RAILWAYS IN 1835

The advantages afforded by railways have now become sufficiently appreciated. They comprise the civilisation and employment of the labouring part of the community; the distribution throughout the whole country of useful expenditure, which the localisation of manufacture and capital has before secured in monopoly to particular districts; the equalisation of the value of property, and more especially rapidity and economy of communication, thereby affording the means of obtaining an intimate knowledge of all the wants and interests of the remoter provinces. Consequent on the appreciation of these objects has been the progress of the railway system throughout Europe and the United States.

In Great Britain, the successful experiment between Liverpool and Manchester gave birth to numerous projects, of which some have been already accomplished; and there are now in profitable operation nearly 250 miles of railway in various parts of that country:—

	Miles
Stockton and Darlington and branches	40
Liverpool and Manchester	32
Railways near Glasgow and Branches...	25
Leeds and Selby	25
Dundee and Newtyle, N.B.	12
Hotton Railway, etc.	10
St. Helens and Runcorn and branches...	12
Wigan and Newton and Warrington ...	14
Clarence Railway	30
Edinburgh and Dalkeith	10
Canterbury and Whitstable	8
Seaham Railway	7
Bolton, Leigh and Kenyon	10

And several others

Within three years the railway from London to Liverpool will be completed, besides various other great connecting lines, altogether 400 miles of railway, are at this time in progress of construction in England alone:—

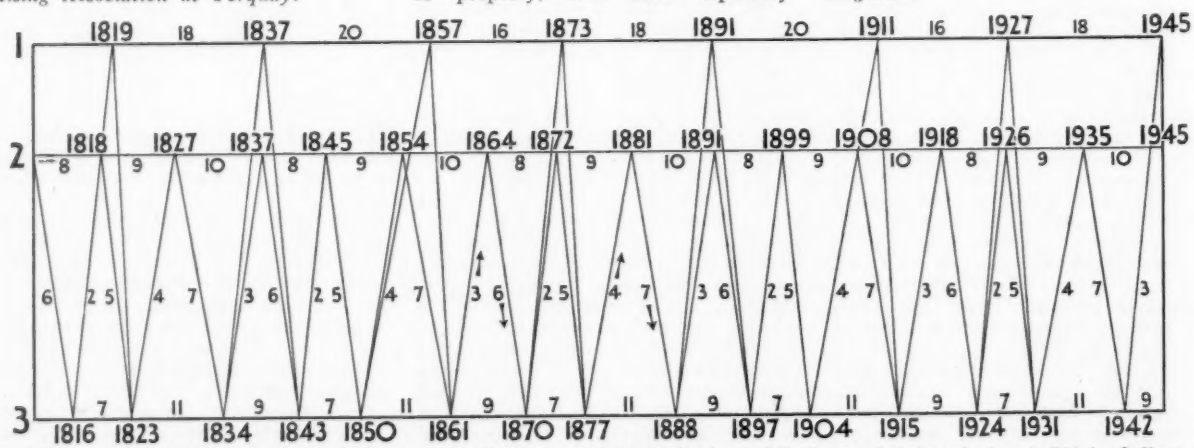
	Miles
London and Birmingham ...	...112
Grand Junction	... 80
London and Southampton ...	... 80
Newcastle and Carlisle ...	... 60
Preston and Wyre	... 18
Bolton, Bury, and Manchester...	... 15

And several others

Applications for 200 miles, including the Bristol line, are before Parliament; and companies are now forming for upwards of 500 miles as follow:—

	Miles
London and York, Cambridge and Norwich	...280
London, Ipswich and Yarmouth	...120
Edinburgh and Glasgow ...	... 50
London and Brighton, and several others	50
London and Greenwich ...	... 3¾

—From an abstract, published in "The Railway Magazine" of August, 1835, of a paper by C. Vignoles, Civil Engineer.



1. Years in which panics have occurred and will occur again. **2.** Years of good times, high prices, and the time to sell stocks and values of all kinds. **3.** Years of hard times, low prices, and a good time to buy houses, stocks, goods, &c., &c., and hold until the boom reaches the year of good times, then unload

In connection with its Diamond Jubilee the firm of Frederick Braby & Co. Ltd., of Glasgow, has re-issued the above trade fluctuation forecast chart, which is known to have been in existence over 60 years (*see editorial note on page* 293)

OVERSEAS RAILWAY AFFAIRS

(From our special correspondents)

NEW ZEALAND

Locomotive Technical Improvements

So successful have been the steady improvements made by the Locomotive Branch in fireboxes and spark arresters, to enable a larger proportion of New Zealand soft coal to be used, that since 1924 the consumption of Dominion-mined coal has risen 300 per cent. In 1924 the department used 94,000 tons of New Zealand coal; by 1926 this total was doubled and by 1929 it was up to 355,000 tons. In 1933-34 the quantity consumed was 381,000 tons and the Dominion had ceased to import any coal for its railways.

Catering for Overseas Visitors

A portable booking and luggage office has now been introduced by the railways on wharves at the main ports and placed opposite the gangways of arriving overseas vessels (see illustration on page 314). This has been arranged with the concurrence of the shipping companies and wharf authorities, as a convenient way to relieve passengers of luggage and other travel worries immediately their vessel berths. Specially selected officials with a wide range of knowledge regarding travel in this country are in attendance to make easy the path of the stranger. All arriving passengers are allowed up to 2 cwt. of luggage free on trains by which they travel.

Improved Communications

The Railway Signals Branch has now perfected a system of telephones to bring every North Island station of importance into immediate touch with the chief executive officers by the use of a telephone dial. This has increased the efficiency of control at head office. The new system replaces the old method of "party wire" rings and reduces the work on railway Morse lines, as well as that formerly going through the Post Office telephone system. It is expected that with the completion of Wellington new station a special cable will be laid under Cook Strait to enable the railways to have the same facility of control in communications with the South Island.

A New Commercial Service

A new feature in the latest pocket timetable produced by the New Zealand Railways is a locality guide, containing over two thousand names of towns, townships or suburbs adjacent to railway stations. These place names have a reference to the page number in the timetables of the station with which they are associated. Business-houses and travellers find this information of great advantage in making arrangements for transport. The difficulty in regard to the smaller places is very pronounced in New Zealand, owing to the large number of Maori names used. Information of this kind has not previously been compiled in one publication. As new pocket timetables are printed every three or four months there will be no difficulty in keeping the information up to date.

Valuable Forestry Department

Eight hundred piles were recently required for foundations of the engine-shed at Wellington new station, and the department called on its own forestry service to supply them. Thinnings were used from a railway plantation of eucalyptus trees in the South Island, this wood being particularly suitable as the piles are required for foundations in damp reclamation ground. But for this supply, imported hardwoods would have had to be used. The thinning of the plantation was also an economical procedure, as the trees had grown to such a size as to require it. The Railway Department is thus beginning to reap the advantage of a policy begun some years ago of setting suitable plantations on stretches of waste ground.

INDIA

Classification of Goods

Mr. Venables, Agent of the East Indian Railway, presided over the conference held at Delhi for a general exchange of views between the railway and commercial interests on the question of railway rating procedure. Mr. S. O. Lyttleton, representing the Associated Chambers of Commerce, emphasised the need for lower rates for short distance traffic in order to meet road competition. Such rates should have some relation to the value of the goods carried. He also suggested that railway freight rates should be made available to the public.

English Methods Advocated

The Indian viewpoint, as put forward by Mr. K. Lalbhai and others, favoured the adoption of the English practice of maintaining station rates registers. Railway rates should be so fixed as to facilitate the movement of goods—particularly agricultural commodities—both over long and short distances. Mr. Lalbhai further urged that all traffic should be carried at railway risk: the feasibility of this proposal was supported by reference to the enormous decrease in the payments made by the railways in recent years as compensation for loss in transit. Another speaker suggested that the difference between railway and owner's risk rates should not exceed ordinary insurance charges for similar protection. It was also proposed that the use of sidings should be encouraged by the offer of liberal siding terms. Winding up the discussion, Mr. Venables thanked all the members present for their suggestions which, he promised, would receive careful attention before the question of the proposed revision of the general classification was finally decided upon.

Attempted Reconciliation of Opinions

The meeting served the useful purpose of attempting to reconcile the various opinions put forward in connection with the proposed revision. While one Chamber of Commerce recommends that simplification of the existing rates system is to be obtained by the adoption of a uniform classification applicable to all railways, another points out that trade will be adversely affected under the pressure of the so-called uniform rates and that the railways will find it difficult to work on commercial principles. Simplification of tariffs, this Chamber adds, should not mean the introduction of uniform rates and uniform classifications, but the use of more scientific methods in the matter of charging, which will give better flow to trade movements and greater power to railway commercial managers to assist local industries at the same time. There seems to be general agreement in the demand for the extension of telescopic rates to through distances.

Road Competition Futile

It has recently been announced by the Madras & Southern Mahratta Railway that the cheap return tickets at concession rates now available in the Bezwada, Masulipatam, Gudivada and Bhimavaram sections will be withdrawn from September next. The concessions were introduced to check bus competition and the withdrawal marks the success achieved by the railway administration in meeting the challenge of the road.

This railway has decided to launch an energetic publicity campaign with the object of attracting visitors to the various festival centres on the line. It is proposed to issue a series of descriptive illustrated pamphlets in English and in the vernaculars, giving full information on each of the places of pilgrimage. The first pamphlet on Tirupati, an important pilgrim centre in South India, will shortly be issued.

Railway Development in South India

Addressing the Mysore Chamber of Commerce recently, Sir Zafrulla Khan, Member for Railways and Commerce in the Viceroy's Executive Council, stated that the Chamrajnagar-Satyamangalam railway connection, proposed by the Mysore Government, depended upon a decision to link Satyamangalam with Tiruppur and Palni. On the question of future railway policy, the Hon. Member referred

to the important changes in the entire railway administration that would soon be effected by the institution of a statutory Railway Board composed of representatives of commerce, agriculture and industries. The new authority would, doubtless, take into consideration all suggestions for a revision of railway policy.

Railway Earnings

The total approximate gross earnings from April 1 to June 30, 1935, amount to Rs. 22·88 crores, or Rs. 51 lakhs less than the figure for the corresponding period of 1934-35. The Bengal-Nagpur, the Bombay, Baroda and Central India and the Eastern Bengal Railways are the only three systems that have so far recorded an advance on the periodic earnings of the previous year. The approximate working expenses of all railways for April and May, 1935, amount to Rs. 785 lakhs, and are Rs. 15 lakhs lower than the figures for the same period last year.

FRANCE

Locomotive Boiler Explosion Inquiry

The Ministry of Public Works has conducted an inquiry into the extraordinary boiler explosion, which wrecked the P.L.M. standard 2-8-2 mixed traffic locomotive of an express from Geneva to Paris near Tenay on August 2, as briefly described in THE RAILWAY GAZETTE of August 9. The force of the explosion was such that the boiler was torn bodily from the frames and carried to a distance of about 200 yards from the line before it hit the ground for the first time. It bounced twice, tearing deep holes in the soil, before it became lodged fast in the third cavity. Apparently the boiler was lifted up in the air high enough to clear the telegraph wires, as they were not damaged. The spot where the boiler fell was about 200 yards from the line and not from where the train pulled up, as erroneously stated in some newspaper reports. The train ran on for about 1,000 yards before the automatic action of the brakes brought it to a standstill.

Ministry of Public Works Statement

M. Baticle, of the Ministry of Public Works, who conducted the inquiry, made a statement in which he pointed out that for safety at least four inches of water should cover the copper firebox crown plate. There were various means of ascertaining the depth of the water, and in order to warn the driver and fireman when the water was dangerously low, three fusible lead plugs were fitted. In the inquiry it was ascertained that the lead had fused, as was shown by part of the torn copper plate left attached to the frame. This fragment of the plate also showed that the copper had been burnt through. It would take seven to eight minutes for the plate to burn through. This means that seven to eight minutes elapsed after the fusing of the lead before the explosion occurred. The question arises as to what the driver and fireman were doing during that interval. Some cause may have prevented them from drawing the fire. What it was will probably never be known as both were killed.

CHINA

Lung-Hai Railway Extension

A $4,860,000 loan has been arranged by the Ministry of Railways' with a syndicate of five banks for the extension of the Lung-Hai Railway from the present terminus at Sianfu to Paochi in western Shensi, and meanwhile, as previously announced, construction is going ahead westwards from Sian.

Soochow-Kashing Chord Line

A chord line, which would short-circuit Shanghai, is under consideration. It would link Soochow on the Nanking-Shanghai with Kashing on the Shanghai-Hangchow-Ningpo line. This chord would give direct access from Nanking, Peiping and North China to Hangchow, Ningpo, the Chekiang-Kiangsi line and to the Canton-Hankow system via Nanchang, without the necessary detour via, and backshunt into and out of Shanghai.

Progress of Hwainan Railway

A further section of the Hwainan Railway from Hofei (Luchowfu) to Chaohsien, about 80 miles in length, was completed early in July, and the remaining similar length to the terminus opposite Wuhu, on the north bank of the Yangtse, will also be finished this year.

Meanwhile the Loho mining area is being linked up with Pengpu station on the Tientsin-Pukow main line, so that the final line will, when completed, run from Pengpu via Loho, Hofei (Luchow), Chaohsien and the Yangtse opposite Wuhu. A survey is also in hand for a branch line from Loho to Chengyang, following the south bank of the Hwai River.

Proposed New Lines: Chekiang-Kiangsi and Kiangsi-Fukien Railways

The survey of the final section of the Chekiang-Kiangsi Railway from Nanchang to Pingsiang, on the Canton-Hankow system, is now in hand and will be completed by the end of September. Meanwhile the construction of the new Nanchang station is in progress.

Funds have been provided for the survey of a new line of railway from Kwangsingfu on the Chekiang-Kiangsi Railway to Yenpingfu, on the Min Kiang, in northern Fukien, a distance of about 120 miles.

An engineering corps is surveying a 40-mile branch from Yuncheng on the Tatung-Puchow Railway in Southern Shansi, to Mouchingtu on the north bank of the Yellow River.

QUEENSLAND

Breaking of Drought

The severe drought which has devastated the western part of Queensland for many months has now been broken by copious rainfalls over the greater part of the affected area. During the past six months nearly 2,000,000 sheep were moved long distances for agistment. The railways will now be required to return most of these to their original pastures.

Overtime in Workshops

For the first time for ten years overtime on a substantial scale has been resorted to in the principal workshops at Ipswich, Rockhampton and Townsville. All of the men in the metal section of these shops are at present each working twelve hours overtime weekly, in order to expedite the repair of locomotives which had fallen into arrears because of inability to spare the engines from traffic.

Financial Results

Cash collections for the year ended June 30 totalled £6,996,984, or £893,102 more than for the previous year. The money actually earned will differ slightly, but not appreciably, from this figure. A material contributing factor to the improvement was the carriage of stock for agistment, as well as fodder for that remaining on original pastures. The expenditure for the year was £4,999,593, an increase of £596,223 over that for 1933-34. This was due to the abnormal traffic involving heavy overtime and other penalty payments, in contrast with short time working in workshops, goods sheds, &c., previously. The net earnings of approximately £2,000,000 were the largest ever recorded.

SOUTH AFRICA

Johannesburg Railway Improvements

In addition to the improved railway facilities within the City of Johannesburg referred to in THE RAILWAY GAZETTE of July 26, it has now been decided to build an entirely new station on the site of the old Village Deep mine at the south end of Eloff Street. The station is intended primarily for the needs of the coloured community, being situated in close proximity to the Municipal native compounds and the new and rapidly expanding industrial area of Selby township. The station will be of the terminal type, though certain lines will run through to the extensive timber yards and oil sites near by. There will be eight tracks served by four platforms. The recently established native township of Orlando has resulted in a considerable increase of traffic on the main line between Johannesburg and Langlaagte, and the new station will afford much relief to that section. Relief will also be afforded Kazerne goods station by the diversion of truck-load traffic to the new station.

THE INFLUENCE OF SPEED ON LOCOMOTIVE HAULAGE CAPACITY AND FUEL CONSUMPTION

An investigation on conventional lines

By T. GRIME, A.M.I.Mech.E., M.Inst.Loco.E.

THE recent experiments in the matter of increased speeds by ordinary steam-hauled trains (instigated no doubt by the results obtained by modern railcars on the Continent) raise the most important question as to the influence of such increases on the vital matters of fuel consumption and haulage costs. The present article deals with the estimated effects of progressively reducing the timing between two points 60 miles apart by 5-minute reductions from 60 to 45 minutes, giving point to point speeds of 60, 65·4, 72, and 80 m.p.h. respectively.

In order to avoid the necessity of corrections for acceleration and gradients, it is assumed that the timings are passing times and that the track is level throughout. A 4-6-0 type simple locomotive of modern British design and proportions is assumed, and the particulars affecting the basis of calculation are as follow: Total engine weight 82 tons, of which 61 tons are on the coupled wheels. The weight of the tender is 54 tons. Assuming that the tender carries an average of two-thirds of its maximum capacity during the run, the mean weight can be taken as 45 tons, or 127 tons for engine and tender. The firebox is taken to have a volume of 194 cu. ft. and a grate area of 32½ sq. ft. and the working pressure to be 220 lb. per sq. in. The tubes are assumed 2 in. external diameter, 11 w.g. thick, and 14 ft. 2 in. between tube plates, so that the approximate absorption efficiency of the boiler is 82 per cent.

The law governing combustion efficiency and firing rate is taken as:—

$$Ec = 104{\cdot}2 - 1{\cdot}74c$$

where Ec is the efficiency of combustion and c the firing rate in lb. per cubic ft. of volume per hr.

The maximum firing rate would be 31·2 lb. per cu. ft. per hr., or a total of 6,050 lb. of fuel, which corresponds to a rate of 186 lb. per sq. ft. of grate per hr. The boiler efficiency at such a forced rate would be only 41 per cent. and the evaporation, assuming 250° F. superheat, would be 26,600 lb. of steam per hr. from 60° F. feed to 220 lb. pressure. This firing rate is double that normally obtaining in fast passenger work and would represent very uneconomical working and, probably, a very heavy expenditure on boiler maintenance. If the firing rate be taken at half the above value (3,025 lb. per hr. or 93 lb. per sq. ft. of grate area), then the combustion efficiency would rise to 77·1 per cent. and the overall boiler efficiency to 63·15 per cent., giving an evaporation of 20,500 lb. per hr. at the same pressure and superheat.

Steam consumption at the speeds considered can be taken at approximately 18 lb. per h.p. per hr. at rail, and on this basis the output at rail would be:—

Maximum	...	...	1,480 h.p.
Desirable limit	...	...	1,140 h.p.

At any speed the available tractive effort can be determined from the formula:—

$T = \frac{375H}{S}$ where T = Tractive effort (lb.), H = Available horsepower, and S = Speed in miles per hour.

With a locomotive of the proportions under consideration, the available tractive efforts would be as under:—

AVAILABLE TRACTIVE EFFORT OF LOCOMOTIVE

Schedule time for 60 miles (minutes)	60	55	50	45
Average speed (m.p.h.)	60	654	72	80
Maximum tractive effort (lb.)	9,250	8,500	7,720	6,950
Desirable limit (lb.)	7,120	6,540	5,940	5,350

To determine the train load, the question of resistances must be considered. For passenger stock Mr. Dendy Marshall's formula obtained from Great Western data can be used. This is:—

$$R = 1{\cdot}7 + 0{\cdot}064V + 0{\cdot}0018V^2$$

where R = resistance in lb. per ton, and V = speed in (m.p.h.)

For speeds under consideration resistances would be:—

Speed m.p.h. ...	60	65·4	72	80
R — (lb. per ton)	12·02	13·58	15·62	18·32

For engine resistance most of the usual formulæ give excessively high results at high speeds.

Lawford Fry, for a six-coupled engine, gives:—

$$R = 10{\cdot}08 + 0{\cdot}126M + 0{\cdot}004M^2$$

where R = resistance (lb. per ton) and M = speed in m.p.h.

At 80 m.p.h. this gives 45·76 lb. per ton or 5,800 lb. total, which, on the maximum output of 1,480 h.p., leaves only 1,150 lb. for the train, giving a maximum train load of 63 tons, which is obviously too low.

Dendy Marshall's formula, $R = 9{\cdot}5 + 0{\cdot}13\ V + 0{\cdot}003\ V^2$, gives a value of 39·1 lb. per ton or 5,000 lb. total. This leaves 1,950 lb. for the train, giving a maximum load of 106 tons, which still seems low, having in mind recently published performances.

Henschel's formula takes resistance on coupled wheels at 16·8 lb. per ton for a four-cylinder six-coupled engine, and 5·6 lb. per ton on carrying and tender wheels.

The engine resistance on this basis is:—

$$(61 \times 16{\cdot}8) + (66 \times 5{\cdot}6) = 1{,}395 \text{ lb.}$$

To this must be added head air resistance for which the formula used is:—

$$R = 0{\cdot}12 \left\{ \frac{1{\cdot}6\ M + 12}{10} \right\}^2.$$

where R = head air resistance in lb. per sq. ft. and M = speed in m.p.h.

At 80 m.p.h. this would give 23·5 lb. per sq. ft., or 2,350 lb. total for an end area of 100 sq. ft., making the total engine resistance 3,745 lb.

In criticism of these formulæ, an allowance of 16·8 lb. per ton on coupled wheels and 5·6 lb. on carrying and tender wheels seems too low for high speeds, when it is considered that the air resistance formula is intended to cover head air resistance only, whereas a figure of 18·32 lb. per ton is allowed for the train at 80 m.p.h. to cover rolling and air resistance.

On the other hand when compared with Dendy Marshall's formula, the head air resistance given by the above

appears to be excessive. Dendy Marshall gives for head air resistance:—

$$r = 0{\cdot}00228\ V^2$$

where V = resistance in lb. per sq. ft. and V^2 = speed in m.p.h.

For an effective end area of 100 sq. ft. this gives 1,460 lb. at 80 m.p.h., as compared with 2,350 lb. from the Henschel formula.

In view, therefore, of the general uncertainty of engine resistance at high speeds it is proposed to take the bold step of assuming the mean resistance of the engine in lb. per ton *at high speeds* to be the same as that of the train and in addition to debit the head air resistance as determined by Dendy Marshall's formula against the engine.

At *high speeds* this assumption should not be very far out, as it is reasonable to assume that the actual rolling resistance of the engine per ton (involving as it does axle loads exceeding 20 tons on coupled wheels of, say, 6 ft. 9 in. dia., as compared with, say, 3 ft. 6 in. wheels and 8 tons axle load for the train) would be very much less than for the coaching stock, thus leaving a very considerable margin to cover for machinery friction.

Accepting the above basis, the resistance of engine and tender can be taken as:—

ENGINE RESISTANCE

Speed (m.p.h.)	60	65·4	72	80
Head air resistance—				
100(0·00228 V^2)	821	975	1,180	1,460
Rolling resistance—				
127(1·7 + 0·064 V + 0·0018 V^2)	1,530	1,727	1,985	2,325
Total engine and tender	2,351	2,702	3,165	3,785
H.p. absorbed by engine	376	472	608	808
Total resistance (Henschel) (lb.)	2,795	3,035	3,335	3,745
H.p. absorbed by engine	446	528	640	799
Difference	+ 70	+ 56	+ 40	− 9

The above table brings out very clearly the important effect of speed increase on the power absorbed in hauling the engine only. The resistances given by the Continental formula are included for comparison only, and it will be seen that the differences obtained, though appreciable at the lower speeds, are not very great in proportion to the total output.

Having formed a basis for engine and train resistance, it is possible to arrive at maximum and desirable loads.

MAXIMUM LOAD RATINGS FOR ENGINE

Passing time for 60 miles (minutes)	60	55	50	45
Schedule speed (m.p.h.)	60	65·4	72	80
Engine h.p.	—	1,480	—	—
Tractive effort at rail (lb.)	9,250	8,500	7,720	6,950
Drawbar pull (lb.)	6,899	5,798	4,555	3,165
Maximum train load (tons)	572	427	291	173
Coal per mile (lb.)	101	92·5	84	75·6
,, trailing ton mile (lb.)	0·177	0·217	0·289	0·437

DESIRABLE LIMITING LOADS

Passing time for 60 miles (minutes)	60	55	50	45
Schedule speed (m.p.h.)	60	65·4	72	80
Engine h.p.	—	1,140	—	—
Tractive effort at rail (lb.)	7,120	6,540	5,940	5,350
Drawbar pull (lb.)	4,769	3,838	2,775	1,565
Train load (tons)	396	282	178	85
Coal per mile (lb.)	50·5	46·25	42	37·8
,, trailing ton mile (lb.)	0·128	0·164	0·236	0·446

The above tables bring out several important factors not always realised. Comparing the last column in the upper table with the second last in the lower, it will be noticed that with approximately equal loads an increase of speed of from 72 to 80 m.p.h. or 11·1 per cent. involves a fuel consumption increased from 42 to 75·6 lb. per mile, or 80 per cent.

A further important item will be observed by a comparison of the last columns in both tables, namely, that the all-important figures of fuel per trailing ton mile are *reduced* when the engine is forced to its limit, or, in other words, at very high speeds, so far as fuel consumption is concerned, overloading pays.

In addition, the pay load capacity of the train is doubled. The effects of this on locomotive design are likely to be far reaching, as it is evident that for these ultra high speed duties the most suitable type of locomotive will be one that can stand up to continual thrashing with the minimum of ill-effects. The objective is to haul the maximum pay load with the minimum engine weight, and the criterion will have to be minimum fuel consumption and maintenance per passenger carried, and not high thermal efficiency.

Streamlining

So far, only the ordinary locomotive and train has been dealt with, no consideration having been given to the possibility of reduced resistance by the adoption of streamlining. Considering a speed of 80 m.p.h., it will be seen that the head air resistance absorbs a pull of 1,460 lb. Further, in the train resistance formula, the component 0·0018 V^2 represents air resistance, and at 80 m.p.h. corresponds to 11·5 lb. per ton. Applying this to the train only (as the desirability of masking the motion, &c., of the engine is debatable) gives 173 × 11·5 = 1,990 lb., so that the total air resistance would be 3,450 lb.

Assuming that by the adoption of streamlining the air resistance could be halved, this would reduce the tractive effort required by 1,725 lb. to 5,225 lb. only. The horsepower at rail corresponding to this would be 1,118 h.p., as compared with 1,480 previously. The steam demand would fall to 20,100 lb. per hr. with a corresponding fuel consumption of 2,970 lb. or 37·2 lb. per mile. In other words, *halving the air resistance* by streamlining has *more than halved the fuel consumption.*

Another method of taking advantage of streamlining is to increase the load. The maximum tractive effort of the engine when working all out at 80 m.p.h. is 6,950 lb. Halving the head air resistance reduces the engine resistance to 3,055 lb., leaving 3,895 lb. available for the train. Halving the air resistance in the train formula gives:—

$r = 1{\cdot}7 + 0{\cdot}064\ V + 0{\cdot}0009\ V^2$ or, at 80 m.p.h., 12·57 lb. per ton,

giving a maximum train load of 310 tons. Tabulating these results we have:—

EFFECT OF STREAMLINING

	Without streamlining		Streamlined (air resistance halved)	
Engine output (h.p.)	1,480	1,140	1,480	1,118
Load (tons)	173	85	310	173
Coal per hr. (lb.)	6,050	3,025	6,050	2,970
,, mule (lb.)	75·6	37·8	75·6	37·2
,, trailing ton mile (lb.)	0·437	0·446	0·244	0·215

It will be noted that streamlining enables a train of 173 tons to be hauled at 80 m.p.h. with an expenditure of fuel per trailing ton-mile actually lower than is attainable with a similar load at 72 m.p.h. without streamlining (compare the above table with the second last column in the immediately preceding table.

It will be evident from the table that streamlining is likely to be an exceedingly important factor if ultra high average speeds with steam trains are to be a future feature of railway operation.

(*See editorial comment on page* 297)

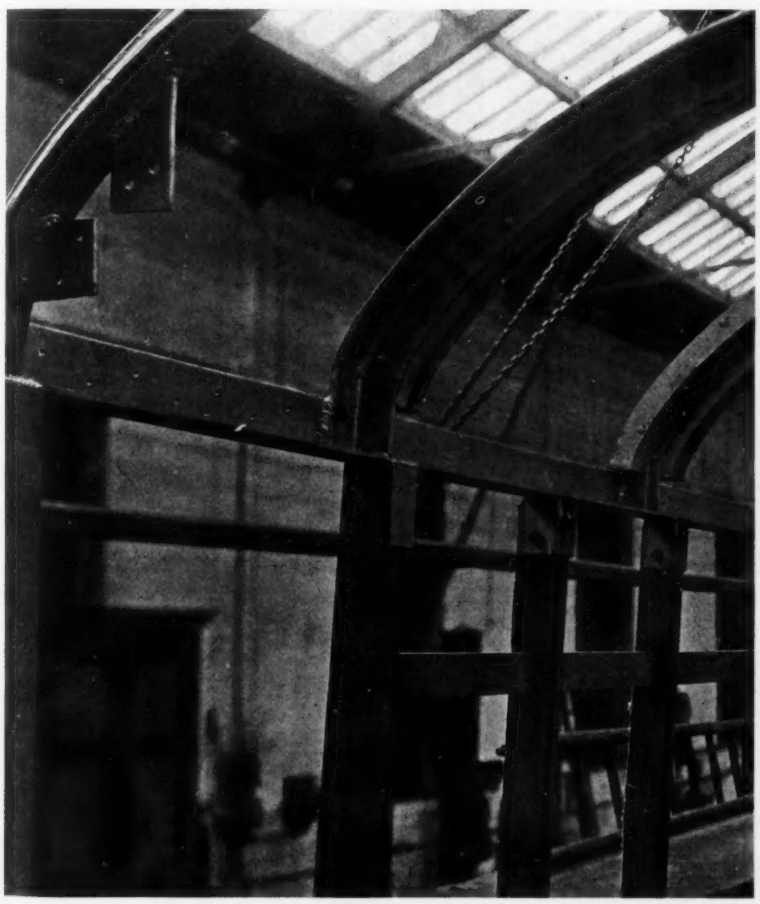
NEW FIRST CLASS SLEEPING CARS, L.M.S.R.

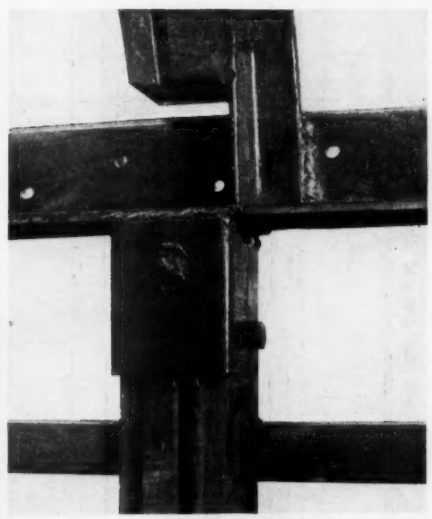
These vehicles incorporate novel constructional methods including the substitution of welding for riveting

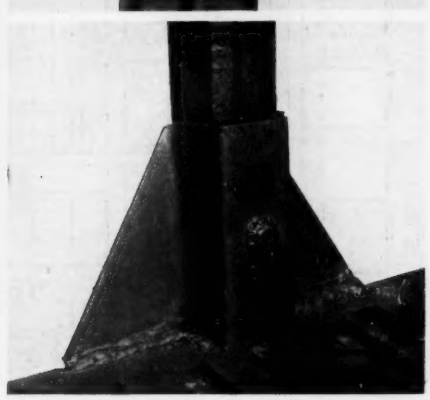
THE first of an order for 26 first class sleeping cars which are being built at the Wolverton Works of the London Midland & Scottish Railway to the designs of Mr. W. A. Stanier, Chief Mechanical Engineer, has recently been put into service. The construction of these vehicles marks a departure from standard practice in that electric arc welding has been used for building up the bogies, underframes and body framing, the body framing being constructed on a new principle. A further feature is that the vehicles are longer and wider than previous cars built by the company, the overall dimensions of the bodies being 69 ft. 1 in. long and 9 ft. 2¼ in. wide. Other dimensions are shown on the drawings reproduced. The extreme width of 9 ft. 2¼ in. has necessitated the recessing of the handles. In general appearance the cars follow the company's latest standard practice, having the windows flush with the exterior steel panelling.

Each car has 12 separate single berth compartments, with a communicating door between each pair. There is a lavatory at one end of the car and an attendant's compartment at the other. The additional width has made it possible to use a slightly longer bed than usual, and the interiors of the compartments have been designed to present plain surfaces with chromium plated fittings, thus facilitating the maintenance of cleanliness, and producing a pleasing effect in trend with modern domestic design.

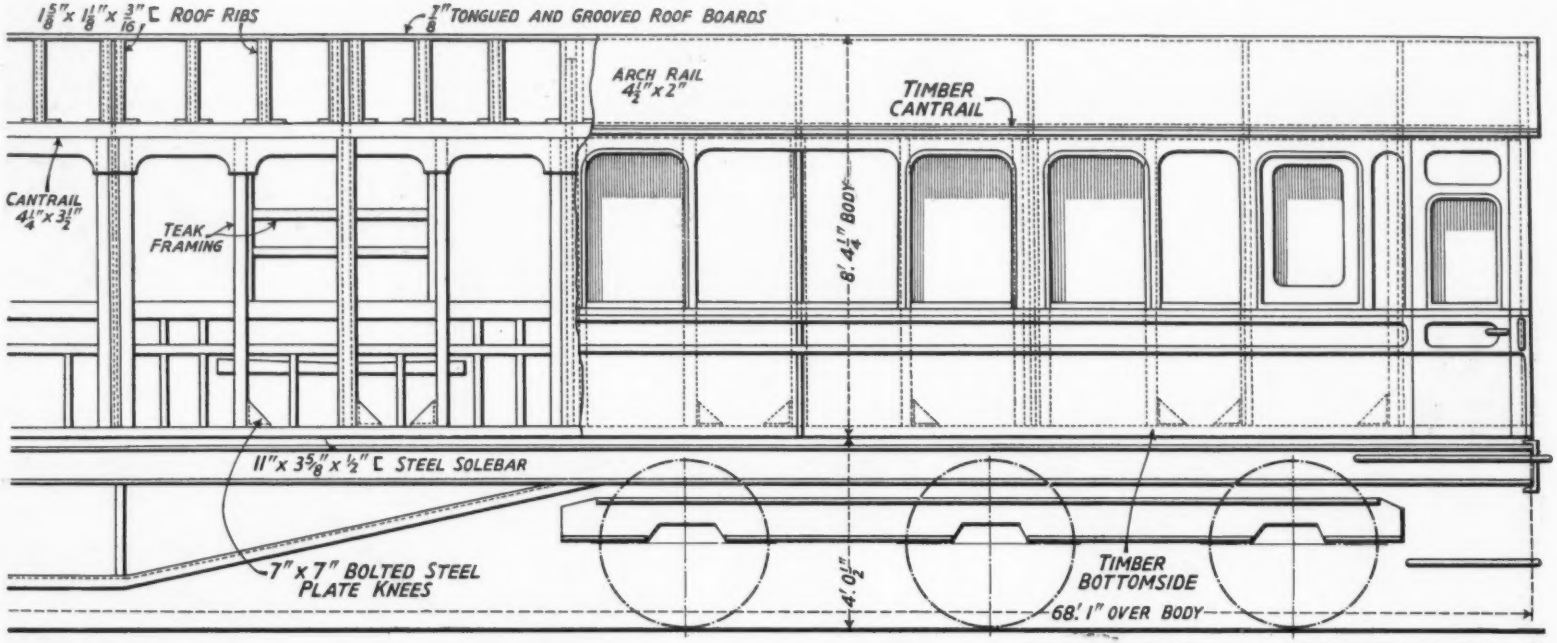
The welded bogies and underframes are based on standard methods of construction, so that standard brakework, springing and other equipment can be used. From the illustration of the bogie, the manner in which the usual rolled-steel sections are welded upon and riveting eliminated will be observed, the only riveting retained being on those parts which require fairly frequent removal, such as the brakework, axleguards and liners. The elimination of rivet holes has made it possible in some instances to use lighter sections. The underframe, also of steel sections, follows the general standard design except for the substitution of welding for riveting. Actually the welded joints have been designed to be stronger than riveting. This method of construction has made it possible to preserve a flush

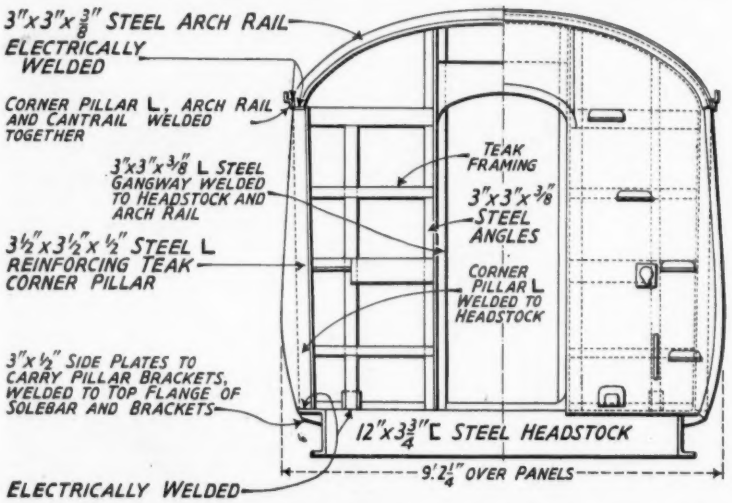


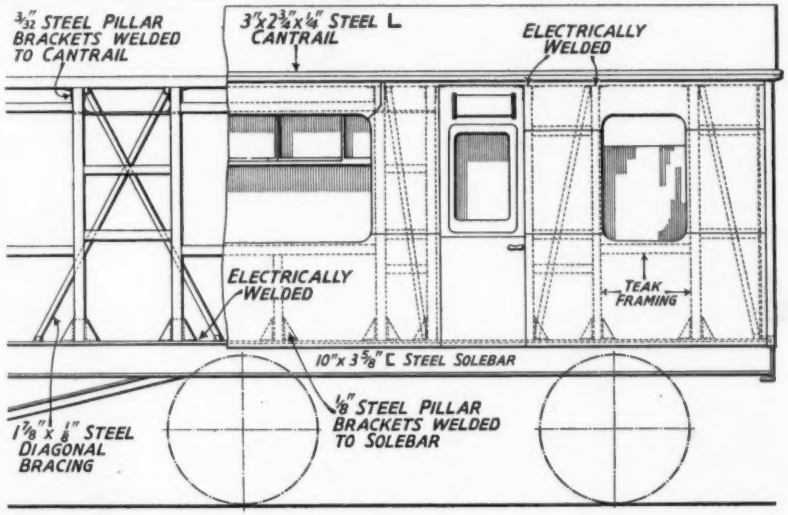




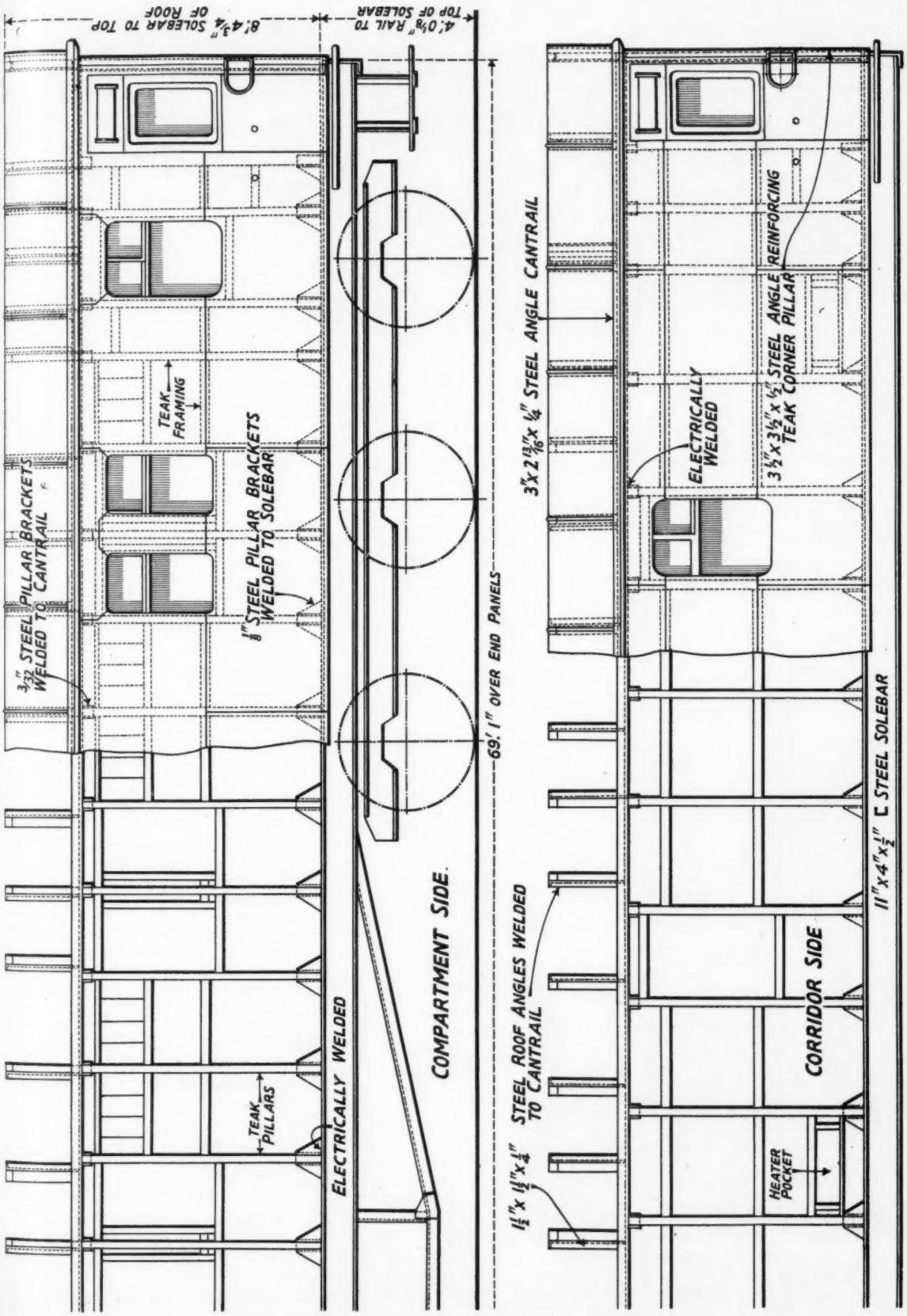
Welded connections of body framing. Left and right (above): Joints between cantrail, roof angles and pillar brackets. Right (below): Joint between pillar, pillar bracket and solebar







Above: Constructional details of former standard sleeping car. *Below*: (*left*) Cross section of new sleeping car; (*right*) constructional details of latest standard corridor stock



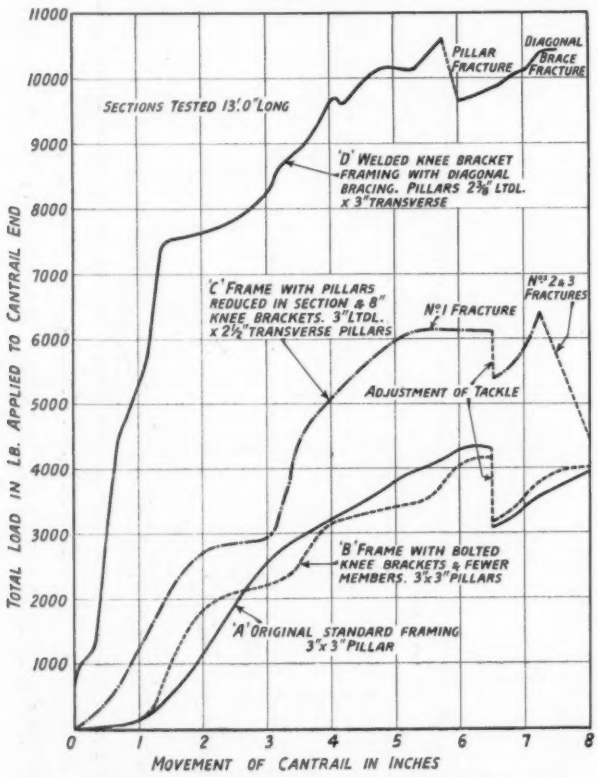
Constructional details of body framing of new sleeping cars

NEW STANDARD CARRIAGE CONSTRUCTION, LONDON MIDLAND & SCOTTISH RAILWAY

top, thus enabling the steel key sheeting which forms the floor base to be welded directly on to the underframe. The body pillars are brought right down to the level of the underframe and thus the use of bottom side members is dispensed with. The method of securing these pillars, which are of teak, has been the subject of numerous tests to arrive at the most satisfactory system. Each end of the pillar is bolted to a box bracket, pressed from $\frac{1}{8}$ in. mild steel and welded directly to the underframe and the cantrail respectively, as shown in our illustrations. The cantrail is made up of lengths of angle section, joined by butt welds, and to it the roof angles and the arch rail angles are welded. The cantrails are drilled for riveting on the roof sheets, which are of 16 S.W.G. steel, and to take the gutter mouldings.

Preliminary Tests

Tests of different types of construction for the body sides were carried out and are illustrated on page 311. First a section with the body knees secured by coach screws was subjected to a shear load (applied by a hydraulic ram at the end of the cantrail), and the resultant distortion and fractures are shown in the photographic reproduction, as well as in curve "A" in the graph below. Another section, modified by the elimination



Results of tests on different types of body framing

of certain members and having body knees bolted through the pillars was then subjected to a similar test and gave the results also illustrated photographically and shown in curve "B" on the graph. The second test showed that even after the reduction in the number of members used, the structure was as strong as the first one. These tests demonstrated that mortised and tenoned timber joints, with body knees, were not the most satisfactory form of structure, while to obtain the maximum strength combined with lightness, timber should be used for compression and steel for tension members and fastenings. Upon these principles the design of box bracket adopted was evolved. Diagonal cross-bracing, of steel bar welded to the solebar and cantrail, has also been incorporated in the latest standard designs for vestibuled passenger stock for the L.M.S.R. Curve "D" on the graph clearly indicates the increased strength obtained by this type of construction. The cross section of the pillars is reduced by about 20 per cent. when this diagonal bracing is used.

Independent tests made both transversely and longitudinally on pillars loaded as cantilevers indicated the comparative strengths of various sizes and methods of securing the pillars, and the graph reproduced below indicates the results, and shows that the new design with box brackets is about twice as strong as the previous standard.

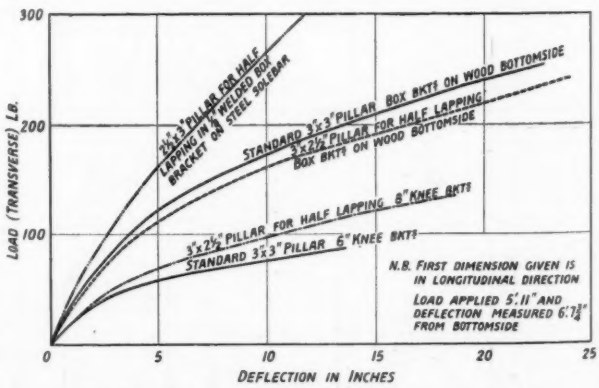
Owing to the wider body of the sleeping cars, increased "turnunder" was necessary, which made it impossible to incorporate cross bracing in these vehicles. Apart from this omission, however, which is to some extent balanced by the additional members necessary in providing the 12 compartments, the general features resulting from the tests have been applied throughout.

The coach ends are built of steel angles, welded together and to the headstocks, two of the angles forming very strong corner pillars. A previous source of weakness in timber ends has been the gangway back angle. This member has now been eliminated and the gangway sheet is fastened to two steel angles which form the door pillars for the end, and extend from the headstock to the arch rail.

The flooring is based on cork slabs shaped to fit the keyed grooves of the steel key sheeting on the underframe. The cork slabs are cemented in position with bitumastic solution, thus forming the surface to receive the felt, on which is laid linoleum, which in turn is covered by rugs in both corridor and compartments. The underside of the floor is sprayed with asbestos $\frac{3}{8}$ in. thick to insulate the interior from track noises. The exterior panelling of the sides and ends is in 16 S.W.G. steel sheet, secured to the wood framing by screws.

Details of Finish and Equipment

The compartments are finished in Rexine in four distinct colour schemes, yellow, green, blue, and beige, with a fade-out from floor to ceiling. The beds, which have a dummy head and foot of polished wood, are made up of a Vi-spring mattress on a spring frame, with hair mattress above. Each compartment has a sliding extractor ventilator light, and a sliding shutter with louvres, running on spring-loaded pulleys. The wash basin, which is of porcelain coloured to match the general colour scheme of the compartment, is housed in a cabinet at the foot of the bed, and has a hot and cold



Results of tests on pillars loaded as cantilevers

New first class sleeping car, L.M.S.R.

water supply. The corridor is finished in walnut and sycamore.

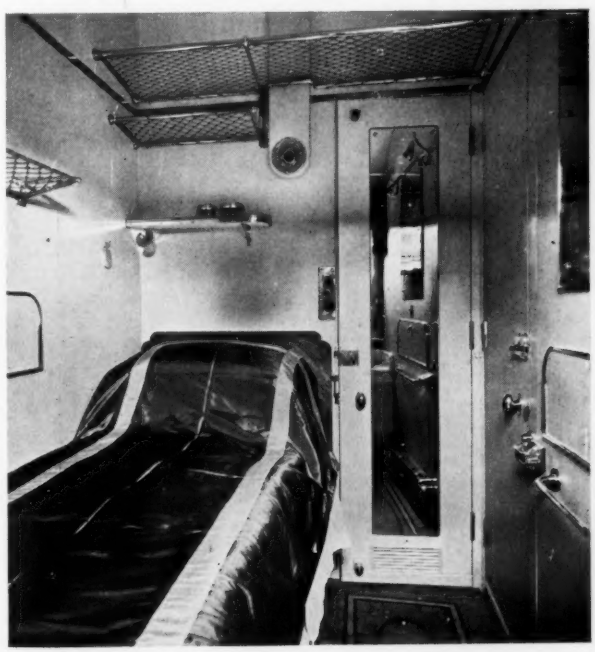
A combined heating and ventilating system of the induced air Themotank type is installed with Thermo-Reg control. Each berth compartment has a Punkah Louvre, fixed accessibly over the head of the bed, by means of which the passenger has individual control of the volume, direction, and temperature of the air entering the compartment. The ventilating equipment is housed above the ceiling of the vestibule adjoining the attendant's compartment, and consists of an electric motor, operating off the coach lighting equipment, direct-coupled to a fan on each side.

Air for the fans is drawn from outside the car, passing first through a metal-wool filter and then through a viscous oil filter, both of which are readily removable for cleaning. One fan delivers the air direct into the cold air duct and the other into a steam-operated air heater from which it passes into the hot air duct. These ducts are insulated and run through the length of the car above the corridor ceiling, with short ducts branching off to the regulators in the compartment.

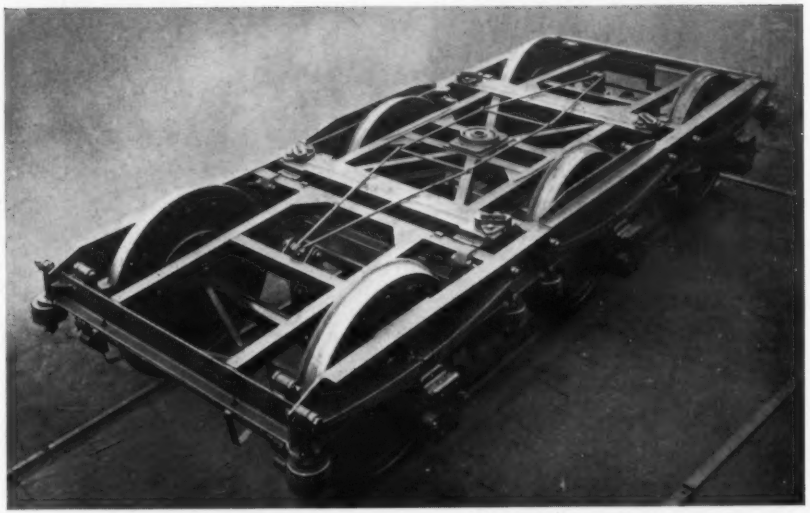
There is a louvred opening at the foot of each compartment door, thereby providing means for a ready circulation of the air. There is also a louvred opening in the vestibule ceiling beneath the ventilating unit which allows a proportion of the delivered air to be re-circulated, all of which passes again through a filter before being directed into the hot-air fan. The ceiling under the unit is in removable sections to give unimpeded access to the ventilating gear. The fans and air heater are controlled from the adjacent attendant's compartment, and there is provision for varying the fan speed in three stages. The capacity of the air heater is sufficient to maintain an adequate temperature in the berths, but to meet the wishes of passengers who desire another source of heat, each berth has also a steam tubular heater at floor level controlled by a wheel valve attached to the heater.

The L.M.S. standard Wolverton system of electric lighting which consists of a variable speed dynamo, a regulator and a battery of 12 lead-acid cells of 250 ampere-hours capacity is used. The cars are wired for R.C.H. through control, but the car lighting is not connected to this, being directly under the control of the attendant. All the lighting is by means of 15-watt, pearl lamps, those in the berths being housed in polished chromium finished reflectors. There is a lamp on the ceiling and one over the mirror on the side wall, in addition to a reading light in the corner over the head of the bed. The latter is controlled by a switch having "dim," "bright," and "off" positions. The switches for the roof light and reading light, together with a bell push to call the attendant, are housed behind a switch-plate on the door pillar beside the bed, while a switch under the mirror controls the lamp above. In the corridor, above each door, there is a drop-indicator for the bell circuit which is coupled through another indicator, and a bell in the attendant's compartment. The attendant's indicator is arranged to show whether the call has originated from the car or from the adjacent car on either side.

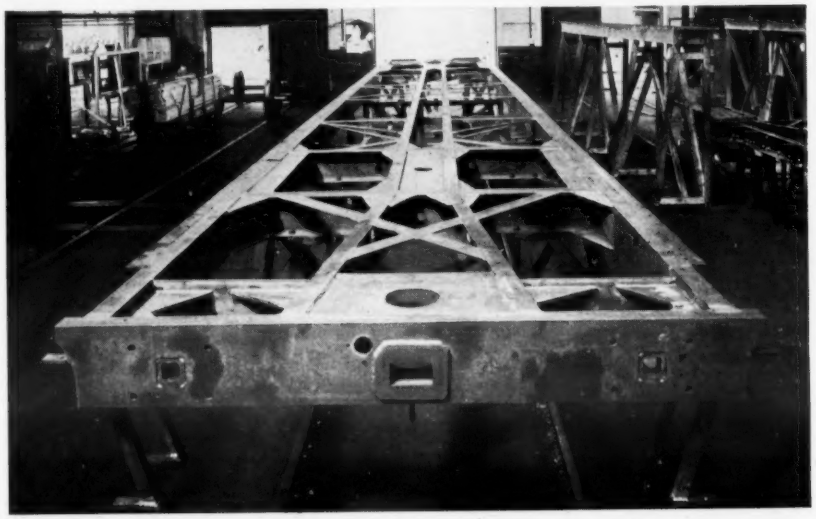
These new sleeping cars, it will be observed, are mounted on six-wheeled bogies, in order to ensure the smoothest possible riding.



Interior of new first class sleeping car, L.M.S.R.

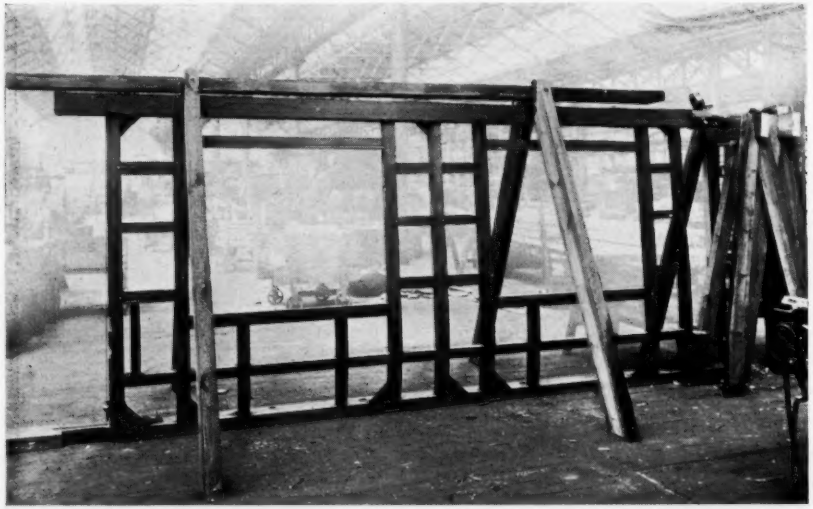


Six-wheel bogie completely welded except parts requiring fairly frequent renewal

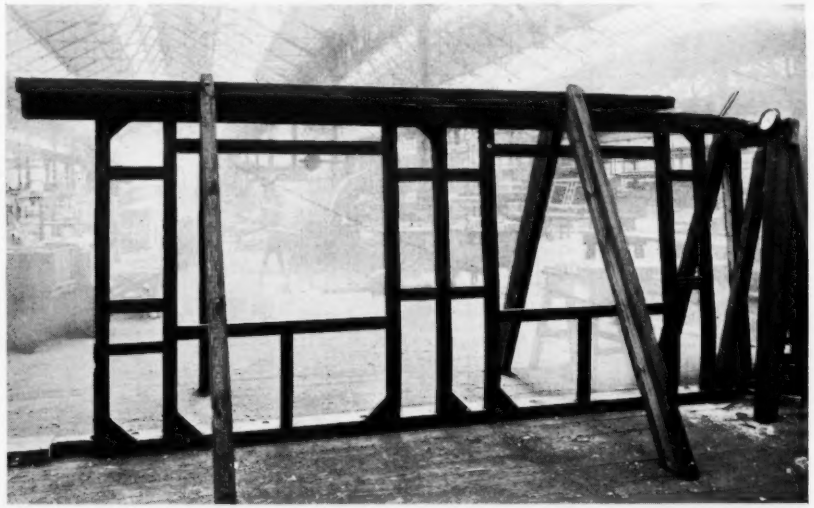


All-welded flush top steel underframe. The welded joints are designed to be stronger than riveting

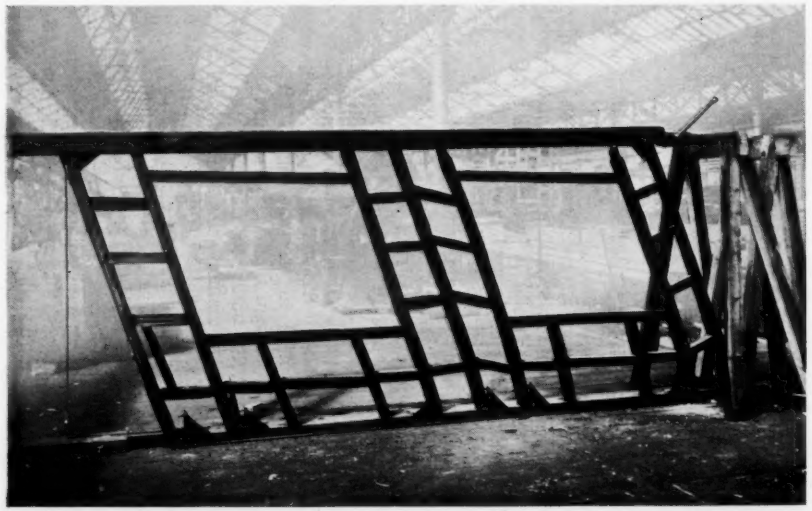
Welding pillar brackets to underframe to which the key-section floor base has already been welded



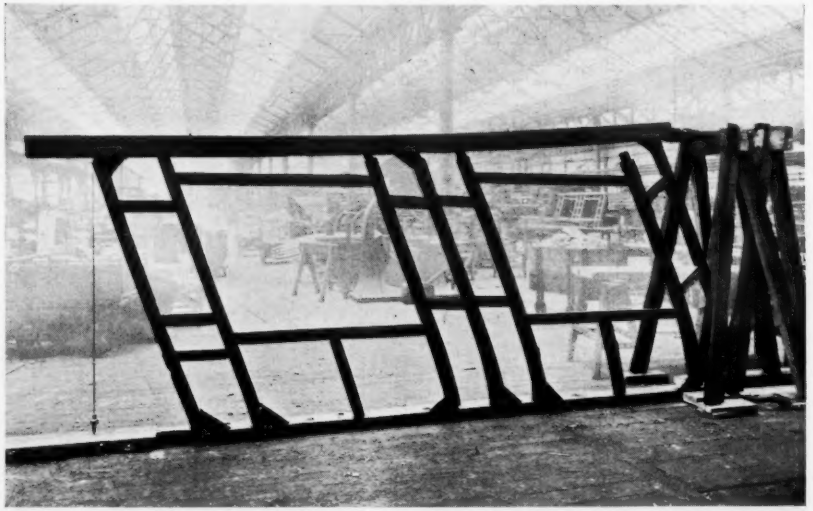
Sections of former standard framing for 57-ft. corridor coach before testing. Body knees are secured by coach screws



Sections of modified design of framing with bolted body knees, before testing



Section of former standard framing for 57-ft. corridor coach after testing. See also Curve A of first diagram on page 308



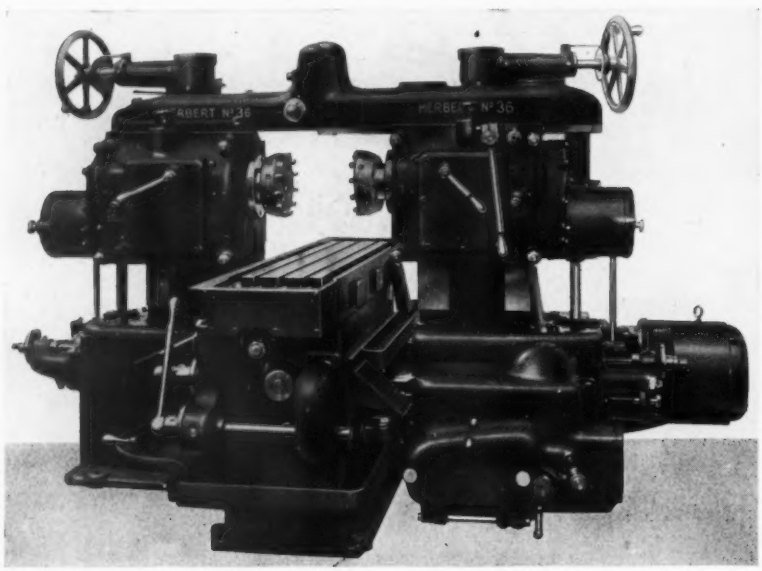
Modified design of framing after testing. See also curve B of first diagram on page 308

NEW STANDARD CARRIAGE CONSTRUCTION, LONDON MIDLAND AND SCOTTISH RAILWAY (see article on page 305)

A NEW HEAVY-DUTY MILLING MACHINE

The Herbert No. 36 machine, available in single and duplex form

THE Herbert No. 36 heavy duty milling machine is available both as a single-head machine and also in duplex form, the latter being shown in the accompanying illustration. The design is entirely new and embodies every desirable feature for the production of milled work in quantities. It is exceptionally powerful and provides a complete automatic cycle of table movements. The wide range of speeds and feeds available enables large or small cutters to be used efficiently in non-ferrous metals as well as cast-iron and steel. Ball-and-roller bearings



Herbert heavy duty duplex milling machine

to the spindle and all shafts, chrome-nickel steel gearing sliding on multiple splined shafts, and automatic lubrication ensure maximum durability in hard service throughout the life of the machine.

That the general construction of the machine is well planned to ensure the absolute rigidity and sturdiness essential to a tool of this type, at the same time giving ease of operation, is obvious from the illustration, and we can also testify to the fact from actual inspection. The column of the single machine is supported and has transverse adjustment on a massive bed which extends down to the foundation. The bed for the duplex machine is a separate casting bolted to the main bed. The two heads are of similar design, both driven from a high-speed flanged type motor bolted to the clutch box on the right-hand side of the machine. The machine in single form requires a 7½ h.p. motor, and 10 h.p. for the duplex. The speed of the motor in both instances is 1,420 r.p.m.

The adjustment provided to each spindle head enables distances between 3 in. and 12 in. to be obtained between the spindle and the table. The right-hand column has a 4-in. transverse adjustment on the bed giving a maximum distance between the spindles of 22½ in. The spindles are of case-hardened chrome-nickel steel, with the large standardised nose in which arbors and cutters cannot stick and with provision for securing face and other cutters directly to the nose. The spindles are bored through and provided with a draw bolt. Each spindle is mounted on two roller-journal bearings; the thrust in both directions is taken by two opposed double-purpose ball bearings which also take part of the journal load. All the spindle bearings are of precision type with their inner and outer races clamped; they are carried directly in two massive housings integral with the head.

Pick-off gears, housed in a casing bolted to the spindle head, enable 16 spindle speeds to be obtained, the standard pick-off gears giving a range of speeds from 20 to 761 r.p.m. There is a gear change in the spindle head operated by a lever with "fast" and "slow" positions. The spindle heads form oil tanks from which filtered oil is pumped over the gears, bearings and other mechanism. The oil flow can be observed through a glass indicator.

When the machine is used in its single form, the heavy box-section overhanging arm is supported in a dovetail guide on the top of the spindle head and moved by rack and pinion. It is clamped by a taper gib operated by a powerful lever. The arbor support has two large precision bearings, one a roller, the other a ball-bearing, placed adjacent to each other and totally enclosed. The support can be made to accommodate different diameters of arbor by the use of interchangeable bushes. In this way the outer end of the arbor is supported in a frictionless bearing permanently in alignment with the spindle.

The clutch box contains the main driving clutch and brake, the reversing bevel gears for the right-hand spindle drive, and the bevel gears which drive the feed box mechanism. The spindle reverse operating lever cannot be left in the neutral position. A safety device is incorporated which prevents the cover over the pick-off gears being opened until the clutch connecting the bevel gears at the bottom of the vertical shaft has been disengaged by a hand lever. With the clutch withdrawn the cover can be opened and the gears manipulated with perfect safety.

The transmission to the table is through a feed box bolted to the front of the bed, which contains the mechanism for the feed and quick-power motion of the table, both forward and reverse, also the continuously rotating double-helical cam by which the main clutch and brake are operated for starting and stopping the spindle automatically. The rate of quick-power motion is 150 in. per min. The feeds, 18 in number ranging from 1 in. to 41¼ in. per min., are varied by pick-off gears in a casing on the front of the feed box, and provided with a safety device similar to that of the speed change. The bottom of the feed box forms an oil tank, from which oil is pumped into a tray that distributes it to the gears, bearings, and other mechanism.

The automatic cycle of table movements is controlled by dogs on the edge of the table. The dogs engage projections on the vertical trip shaft, causing it to rotate and also to move axially up and down. The trip-shaft is carried in a control box bolted to the side of the bed. A universal lever projecting from the box enables the motions of the table to be controlled by hand when required. Change from hand to automatic control and vice versa is made by the movement of a knob on a bracket bolted to the end of the base. Apart from its control of the table movements, the rotating trip shaft also operates the starting and stopping of the spindles.

All gearing is of nickel-chrome steel, hardened or heat-treated as required; the spur gears have ground teeth. The worm gears are of phosphor bronze, while the worms themselves are nickel-chrome steel ground and polished on the threads. Multiple splined shafts are used for all sliding gears, and ball or roller-bearings are used wherever possible. Lubrication throughout is automatic as far as practicable.

Roller Bearing Axleboxes for Goods Wagons

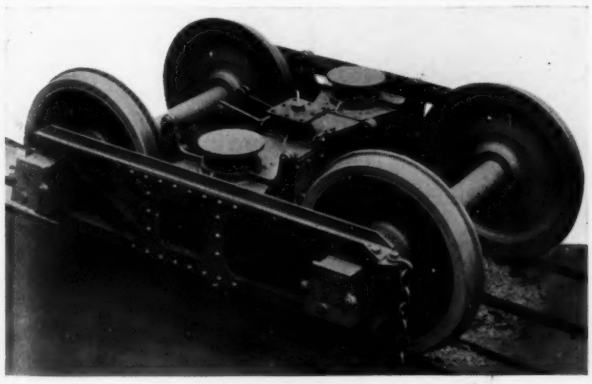
FOR passenger rolling stock the use of roller bearing axleboxes has extended widely in recent years, particularly on the European continent and in America, and now the equipment of goods wagons is also proceeding. Amongst recent deliveries may be mentioned 16,000 SKF axleboxes for 400 new four-wheeled goods wagons for high speed traffic. These wagons are intended primarily for the transport of fresh fruit and vegetables from France to London by the train ferry. They are designed for a maximum speed of 100 km.p.h. (62¼ m.p.h.). One advantage claimed for this type of bearing for this particular service is that it eliminates the possibility of the escape of oil from the bearings during the rolling of the ship in rough weather.

The special sleeping cars built by the International Sleeping Car Company for the London-Paris service by way of the Calais-Dunkirk ferry are also equipped with SKF roller bearings. These vehicles were described in THE RAILWAY GAZETTE of March 23, 1934.

Sheffield Twinberrow Wagon Bogie

ON page 280 of last week's issue appeared a description of some new cattle wagons now being built by the Birmingham Carriage & Wagon Co. Ltd. for the Nigerian Railway, and mention was made of the fact that these are mounted on Sheffield Twinberrow type bogies fitted with Framwel welded axleboxes.

In this type of bogie the load is carried upon two circular side bearers which are supported by compound helical springs, giving an easy support to the body when light, and a suitable degree of resistance to cushion the total load. There is ample clearance between the centre pin pivot and the centre pin guide, and between the circular side spring boxes and their guides to permit of longitudinal and transverse tilting upon curves or inclines. The method of carrying the load upon side bearers, coupled with the rigidity of the side frames reduces hunting and effects a considerable saving in the wear and tear of tyres and flanges.



Bogie for Nigerian Railway cattle wagons

The main bolster consists of a wide channel member united to the arch bar by means of a wide gusset plate each side. The channel bar is trussed by means of transverse angle bars, the upper and lower members being united by web plates, to take the shear forces. The top arch bar and bottom side ties are of channel section, and being of considerable width, are subject to very small deflections when transmitting the maximum amount of lateral force. The inverted arch member consists of a plain bar of rectangular section, which is carefully fitted in order to eliminate secondary stresses. There are only three British Standard steel sections used in the structure.

A special feature of these new Nigerian bogies is that they each weigh complete without wheels and axles only 19½ cwt., and the design permits of a total weight of 40 tons on the rails to be carried by a pair of them. No cast steel details are employed, the spring cups and spring rings, brake block suspension brackets and centre pivot guides being entirely welded. The Framwel axleboxes, being of welded instead of cast construction, assist considerably in reducing the total weight of the bogie. Also, as the load is carried on the side-bearers, the bending moment is negligible, and that on the vehicle main bolster reduced by 45 per cent.

Above: The attractive exterior and window displays of the new Piccadilly offices of the Compagnia Italiana Turismo and (left) the interior of the main hall showing the frieze of modern sketches and the Fascist emblem which help to create an Italian atmosphere in the heart of London (*see editorial note on page* 294)

Right: Portable type of booking and luggage office, New Zealand Government Railways. This is placed on the wharf opposite the gangway of an arriving overseas vessel at a main port, and provides a convenient method of relieving passengers of luggage and travel worries immediately they disembark. It is also used as an enquiry office (*See Overseas paragraph on page* 301)

RAILWAY NEWS SECTION

PERSONAL

It is with regret that we note the sudden death, as the result of a motor-car accident in Germany, on August 15, of Sir Basil Blackett, K.C.B., K.C.S.I. From 1922 to 1928 he was Finance Member of the Viceroy's Council in India, and was responsible for that very important measure, the separation of railway finance from the Indian Budget. He was also a brilliant member of the Civil Service and financial expert, as well as a Director of the Bank of England, and the whole Empire has suffered a great loss in his untimely death at the comparatively early age of 53.

We regret to record the death, on August 13, of Mr. E. M. Brough, who retired in 1930 from the position of chief claims representative in the Chief Goods Manager's office, L.M.S.R, after 42 years' service. Mr. Brough joined the former North London Railway at Broad Street in 1888, and, after special training at Watford, was appointed to the General Manager's office at Euston in 1890. Three years later he was transferred to the Assistant Goods Manager's office, and in 1906 became chief claims representative in the Chief Goods Manager's office. He also acted as chairman of various committees from time to time, including the Railway Clearing House Joint Claims Committee, the Claims Prevention Committee, &c. Mr. Brough's responsible position with the L.N.W. and L.M.S. Railways involved his close contact with many large industrial firms throughout the country, as did his Clearing House connections, which also brought him into touch with representatives of many other railways. He was therefore very widely known and respected.

Mr. Albert Leslie Wright, Managing Director of the Butterley Co. Ltd., has been elected Chairman, but continues to perform the duties of Managing Director also. Mr. Arthur FitzHerbert Wright, late Chairman, retains his seat on the board.

Mr. F. H. Wright, in addition to continuing to serve as a Director of the firm, has now taken up the position of General Manager.

Mr. A. B. Crookall, Chairman of the Isle of Man Railway, left estate valued at £94,700 (£61,730 net).

Mr. E. L. Manley, M.Inst.C.E., who, as announced in THE RAILWAY GAZETTE of April 26, has been appointed to officiate as Agent of the Eastern Bengal Railway, in the absence of Mr. A. F. Harvey on leave, was educated at Cheltenham College and the Royal Indian Engineering College, Coopers Hill. Thereafter he became a pupil on the Great Western Railway and was appointed an Assistant Engineer on the Indian State Railways in 1908; he was promoted Executive Engineer in 1916. He saw war service in Mesopotamia, was afterwards Government Inspector of Railways in Burma, and has subsequently been a Senior Inspector. Mr. Manley was promoted to officiate as Deputy Chief Engineer in 1929 and has also held the appointments of Deputy Agent (Works) and also (Organisation), E.B.R., at different times, and has now vacated the latter to become the chief executive of that railway. He is a Member of the Institution of Civil Engineers.

Mr. E. L. Manley,

Appointed Officiating Agent, Eastern Bengal Railway

Mr. W. H. Liley, A.M.I.Mech.E., Deputy Chief Engineer, Signals, Great Indian Peninsula Railway, has been granted leave preparatory to retirement, and Mr. H. E. Cox has been appointed to officiate in his place as from July 29.

Mr. W. H. Liley gained experience on the Taff Vale and Metropolitan Railways prior to being appointed Assistant Signal Engineer on the G.I.P.R. in 1907. After completing the signalling for the Lonavla-Poona doubling, he was in charge of the interlocking installed at 135 single line stations and in 1914-15 was engaged in the signalling of the Bombay-Kalyan quadrupling. Afterwards he carried out the signalling changes involved by the Shegaon-Nagpur doubling and other important works, until, in 1917, he was appointed Signal Engineer; he was promoted to the Deputy Chief Engineer grade in 1928. Under Mr. Liley the whole of the main and more important branch lines have been mechanically interlocked and Victoria terminus, Bombay, has been remodelled and equipped with electro-pneumatic interlocking. The G.I.P.R. was also the first line in India to install automatic signalling and colour light signals. Mr. Liley has, for a number of years, been a member of the Railway Board's Signalling and Interlocking Standards Committee, and of the Signal Engineers' Committee, Indian Railway Conference Association. Mr. Liley's portrait will be found on the following page.

Mr. H. E. Cox, who officiates as Deputy Chief Engineer, Signals, vice Mr. Liley, on leave prior to retirement, began his career on the G.W.R. in 1910, as a pupil of Mr. A. T. Blackall, M.Inst.C.E., then Signal Engineer; Mr. Cox was afterwards appointed a draughtsman in the office at Reading. He resigned to join the G.I.P.R. in 1915, as junior Assistant Signal Engineer, and, in April, 1921, was appointed Chief Assistant. In September of the same year, while on leave in England, he was placed on special duty by the home board of the old G.I.P. Railway Company to report to them on automatic train control. From 1926-30, Mr. Cox was in charge, under Mr. Liley, of the power signalling construction works carried out in the Bombay suburban area, and during 1930, while again on leave in England, he was invited to attend the meetings of the B.S.I. sub-committee, drafting the new specification for electric lamps for railway signalling. He has prepared a

large amount of the detailed work for the Railway Board's Signalling and Interlocking Standards Committee, and in July of this year, was chairman of the sub-committee appointed to draft a revision of chapters II and XI of the I.S.R. General Rules.

Mr. W. H. Liley,

Signal Engineer or Deputy Chief Engineer, Signals, Great Indian Peninsula Railway, 1917-35

Mr. H. Chambers,

Appointed Locomotive & Personal Assistant to the Chief Mechanical Engineer, Euston, L.M.S.R.

Mr. T. H. Bygate, who, as announced in THE RAILWAY GAZETTE of August 9, retired from the position of District Engineer, Darlington, London & North Eastern Railway on July 31 joined the North Eastern Railway and was posted to the drawing office at York in 1889. In 1896 he was transferred to the drawing office of the N.E.R. Docks Engineer at Hull, but some two years later returned to York. In 1899 he was appointed Chief Assistant to the District Engineer at Hull, the position he continued to hold after the amalgamation. It was in November, 1927, that Mr. Bygate was promoted to be District Engineer, Darlington, L.N.E.R., the post from which he has just retired.

Mr. T. H. Bygate,

District Engineer, Darlington (N.E. Area), L.N.E.R., 1927-35

Mr. E. G. Garstang, M.Inst.T., who, as announced in THE RAILWAY GAZETTE of August 9, has been appointed District Goods Manager, Bolton, London Midland & Scottish Railway, was appointed Assistant Steamship Manager, Goole Steam Shipping, Lancashire & Yorkshire Railway, in 1912. Three years later he was transferred as Assistant to the Eastern District Goods Manager, and from 1917 to 1919 occupied a similar position in the Central District. In the latter year he was promoted to be Dock and Railway Superintendent, Wyre Docks, Fleetwood, the post he continued to hold after the amalgamation, under the L.M.S.R. It was in October, 1926, that Mr. Garstang was appointed Steamship Manager, Goole Steam Shipping, and it is consequent upon the amalgamation of the Goole Steam Shipping as part of the Associated Humber Lines that he has been transferred to Bolton as District Goods Manager. Mr. Garstang is a member of the Institute of Transport.

Mr. H. Chambers, who, as announced in THE RAILWAY GAZETTE of August 9, has been appointed Locomotive and Personal Assistant to the Chief Mechanical Engineer, Euston, L.M.S.R., began his locomotive career with the old Midland Railway in the Derby locomotive works and passed through the principal workships, including a period as a pupil fireman: later he was transferred to the locomotive drawing office. He subsequently obtained the position of Senior Locomotive Draughtsman with Beyer, Peacock & Co. Ltd., Manchester, but returned to the Midland Railway locomotive drawing office at Derby in 1913. On the formation of the L.M.S.R. in 1923, Mr. Chambers was appointed Chief Locomotive Draughtsman of the Midland Division of that group. Four years later he was promoted to be

Kendall] *[Goole*

Mr. E. G. Garstang,

Appointed District Goods Manager, Bolton, L.M.S.R.

Mr. T. F. Coleman,

Appointed Chief Draughtsman (Headquarters), Derby, Chief Mechanical Engineer's Department, L.M.S.R.

Technical Assistant and Chief Locomotive Draughtsman of the L.M.S.R., and served in this capacity under three Chief Mechanical Engineers, namely, Sir Henry Fowler, Mr. E. J. H. Lemon and Mr. W. A. Stanier. In 1934, Mr. Chambers also took over the carriage and wagon section drawing office. Since the amalgamation he has been engaged in the production of drawings for new standard types of locomotive, notably the "Royal Scot" class, and

later, Mr. Stanier's " Princess Royal " class. He is a Member of the Institution of Mechanical Engineers and also of the Institution of Locomotive Engineers.

Mr. T. F. Coleman, who, as recorded in our issue of August 9, has been appointed Chief Draughtsman (Headquarters), Derby, Chief Mechanical Engineer's Department, L.M.S.R., began his career as an apprentice with the firm of Kerr Stuart & Company, engineers and locomotive builders, Stoke-on-Trent, in 1900. In 1906 he entered the service of the former North Staffordshire Railway at Stoke works as Works Plant Draughtsman, and later was transferred to the locomotive and carriage and wagon drawing office. When the railway amalgamation took place at the beginning of 1923, Mr. Coleman was made Chief Draughtsman at Stoke. In September, 1926, he was appointed to the position of Chief Draughtsman at Horwich locomotive works, where he remained until he received the appointment, in October, 1933, of Assistant Chief Draughtsman (Headquarters) and Chief Draughtsman at Crewe, the position he now relinquishes to go to Derby as Chief Draughtsman, Headquarters.

THE MONTH'S RAILWAY LAW

Invitation to Alight

Reading v. *London Passenger Transport Board.* (May 20.)

This was an interesting (unreported) case tried before His Honour Judge Dumas, sitting at Westminster County Court without a jury, on May 20. It appeared that the plaintiff was injured by a fall incurred when alighting from a tube train at Wood Lane station. The station is on a curve, and there is a gap between the platform and the step of the train, which makes it necessary to alight with care. The same is true no doubt of other stations, for example, the Bank station, but at any rate the plaintiff failed to look out and fell down. There are a great many decided cases as to the duty of the railway company, in " inviting " a passenger to alight, to give people warning where there is any danger. But, to quote Mr. Leslie's well-known work on the " Law of Transport by Railway," any attempt to extract a fixed rule of law from these cases is foredoomed to failure. There is no doubt that if a passenger gets out with undue precipitancy and is injured he is guilty of contributory negligence and cannot recover. In the present case the judge, after hearing the plaintiff's evidence, non-suited him on the ground that anyone travelling on the tube must know whether the platform is straight or curved unless it is badly lit, and that the plaintiff failed to take ordinary care. It would be difficult to complain of this decision were it not that it was arrived at before the defendants had given evidence as to the precautions which they had taken to warn passengers of the danger. A passenger is in the position of an invitee and is entitled to expect reasonable care to be taken for his safety. If he is injured he is in a better position than a mere licensee who is on the premises by leave of the owner. If a licensee is injured by a fall he must show that the obstacle or hole in the ground is in the nature of a hidden trap, and only on doing so can he recover. The rule in *Bridges* v. *North London Railway* (1873) L.R. 7 H.L. 213 is that the question whether negligence is to be inferred from a given state of facts must always be left to the jury. The House of Lords appears to have disagreed with it in *Metropolitan Railway* v. *Jackson* (1879) 3 A.C. 193, but it is none the less a satisfactory rule in most cases, and one which gives confidence to the public who are continually exposed to the risks of transport. Where there is no jury the same result is reached by the Judge refusing to non-suit the plaintiff, and proceeding to hear the evidence for the defence before he gives his decision. Mr. Quintin Hogg (a son of the new Lord Chancellor) and Mr. Ivor Lloyd appeared for the plaintiff in this case, and Mr. Blain for the London Passenger Transport Board.

Damages for Fatal Accidents

Slater v. *Spreag.* (*The Times*, August 2.)

Recently the Law Revision Committee recommended that the right of a man's dependents to claim damages in the event of his death, where it is due to the negligence of another, should be extended, and that these rights should be in addition to and not in derogation of rights conferred by the Fatal Accidents Acts. Effect was given to this by the passing of the Law Reform (Miscellaneous Provisions) Act, 1934, Section 1, which provides (1) that " all causes of action subsisting against or vesting in him shall survive against or as it may be, for the benefit of his estate "; and (2) that " where a cause of action survives for the benefit of his estate, the damages recoverable shall be calculated without reference to any loss or gain to his estate consequent on his death, except that a sum in respect of funeral expenses may be included." The effect of these provisions coupled with those of the Fatal Accidents Acts were discussed in *Slater* v. *Spreag*, in which Mr. Slater, who was a chimney sweep earning about £5 a week, was killed.

Expectation of Life

One would naturally suppose that the wife—who was the plaintiff in Slater v. Spreag—was entitled to recover any damages for the loss of her husband which she could not recover under the Fatal Accidents Acts. But the matter was complicated by the decision of the Court of Appeal in *Flint* v. *Lovell* (1935) 1 K.B. 354, in which it was held that damages awarded to a man living might include a sum for the shortened expectation of life caused by the injury. Here Mr. Slater, who was 44 years old, was unconscious from the moment of the accident and only lived for 48 hours afterwards. There was no doubt that the widow was entitled to recover compensation under the Fatal Accidents Act, and as to this the Judge, Mr. Justice MacKinnon, awarded her £1,850, together with £18 for funeral expenses which the Act of 1934 now allows.

But the additional claim by the widow under the Act of 1934 as administratrix of his estate still remained to be dealt with. That Act excludes in Section 1, sub-section 2 (c), a claim for loss of future earnings, because damages have to be calculated " without reference to any loss or gain to his estate consequent on his death "; but it obviously admits claims for damages for (1) pain and suffering incurred, and (2) shortened expectation of life.

Mr. Slater, being unconscious, had not suffered any pain before his death, and the only claim that could be substantiated was for the " mental effect of knowing that his life was shortened." This might arise, said the Judge, if a man found that as a result of the accident he was no longer a healthy man but a nervous and crippled wreck. The compensation is thus given according to *Flint* v. *Lovell* (1935) 1 K.B. 314 for mental distress. But here again, as Mr. Slater did not regain consciousness, this effect was not produced, and such a claim was not vested in him at the time of the accident. The damages therefore remained at £1,868. None the less, Mr. Justice MacKinnon's judgment is illuminating as showing the meaning of the Law Reform (Miscellaneous Provisions) Act, Section 1, and the claims which can logically be made under this heading.

The Long Vacation

The Courts rose on July 31 at the close of the Trinity sittings, and will not sit again until Tuesday, October 8. Mr. Justice Lewis (the new judge) was in the middle of the hearing of *Grein* v. *Imperial Airways Limited*, a claim for damages under the Fatal Accidents Act in connection with the crash of the air liner *Apollo*. The hearing will be resumed in October. The Railway and Canal Commission and the other transport tribunals have made good headway with their work during the past term, and matters are more forward than is usually the case at this time of the year.

Home Railway Returns for 1934

Returns of the capital, traffic, receipts, working expenses, and operating results of the railway companies of Great Britain for the year 1934 have now been issued by the Ministry of Transport, following on the preliminary statement published in March. The aggregate figures do not now include those of the London Transport railways.

The amount appropriated for the payment of interest and dividends in 1934 was £33,113,722, compared with £30,832,409 in 1933, £28,840,481 in 1932, £35,090,153 in 1931, £40,366,120 in 1930, and £44,994,696 in 1929. These figures represent 2·97 per cent., 2·76 per cent., 2·59 per cent., 3·16 per cent., 3·64 per cent., and 4·08 per cent., respectively, upon the total capital receipts. On ordinary stock issued the average return per cent. was 0·86 in 1934, against 0·76 in 1933, 0·57 in 1932, 0·95 in 1931, 2·20 in 1930, and 4·05 in 1929.

The length of road open for traffic at December 31, 1934, was 20,234 miles, a decrease of 17 miles. Expressed as single track, the total mileage of running lines was 36,939 (a decrease of 62 miles), and of sidings 15,658 miles (an increase of 20 miles). Of traffic locomotives there were 20,543 steam, against 20,983, electric 13 (the same), and petrol, oil and oil electric 17 against 9. Amongst rail-motor vehicles are included 1,514 electric (against 1,493), and 158 "other" (against 160). Passenger-carrying vehicles together numbered 44,436, a decrease of 683. The number of merchandise and mineral vehicles fell from 647,000 to 636,201, and the total tonnage capacity of these vehicles, excluding brake vans (13,329), was 7,224,910 tons, a decrease of 62,081 tons. The average capacity per vehicle rose, however, from 11·50 tons to 11·60 tons. Twelve-ton wagons have increased in numbers from 154,118 in 1925 to 266,330 in 1933 and 277,628 in 1934. Of wagons (other than special vehicles), of 20 tons capacity and over there were 29,102 at the close of 1934, of which 26,977 were allocated specially to mineral traffic. Corresponding figures at the end of 1933 were 28,514 and 26,446 respectively. Private owners' vehicles registered in 1934 included 4,950 12-ton and 1,007 20-ton coal wagons. Railway-owned containers increased from 8,553 in 1933 to 10,514 in 1934.

Total receipts from passengers were £52,271,797, an increase of £1,147,199 or 2·24 per cent., principally due to summer tickets and other reduced fares operative throughout the year. Passenger journeys at standard fares were only 14·68 per cent. of the total ordinary passenger journeys in 1934 as against 64·97 per cent. in 1924, and the corresponding receipts were 16·49 per cent. in 1934 and 65·59 per cent. in 1924. Third class season ticket receipts rose from £5,725,221 to £5,833,732, and second class from £397,073 to £408,506, but first class seasons brought in £77,217 less, at £1,616,166. Gross receipts from parcels and miscellaneous passenger train traffic (excluding mails and parcels post) were £12,827,551, an increase of £110,706 or 0·87 per cent.

The total tonnage of higher class merchandise rose from 42,479,210 tons in 1933 to 45,185,204 tons in 1934. Of minerals and merchandise (Classes 1-6) 50,847,917 tons were conveyed in 1934 against 43,116,527 in 1933, and the weight of coal, coke and patent fuel rose from 165,451,758 tons to 173,987,707 tons. Excluding free-hauled traffic, the average haul for higher-class merchandise traffic and livestock was 102·86 miles in 1934 compared with 101·67 miles in 1933; and the average receipt per ton-mile was 2·040d. against 2·097d. For minerals and merchandise (classes 1-6) the average haul fell from 63·79 miles to 63 miles and the average receipt per ton-mile fell from 1·021d. to 1d. The average haul for coal, coke and patent fuel rose, however, from 41·96 miles to 42·03 miles, although the average receipt per ton-mile fell from 1·046d. to 1·038d. The average receipt per ton of merchandise (excluding classes 1-6) was 17s. 5¼d. compared with 17s. 8¾d. in 1933, per ton of minerals and merchandise (classes 1-6) 5s. 2¾d., compared with 5s. 5d., and per ton of coal, coke and patent fuel 3s. 7½d., compared with 3s. 7¾d. As in 1932 and 1933 the average receipt per freight train-mile for all freight, including live-stock, was 13s. 2d.

Expenditure on railway working increased by £3,660,258, but the operating ratio fell from 82·28 per cent. to 81·49 per cent. Maintenance of way and works increased by £4,627,449 gross and £2,212,001 net. Locomotive running expenses were £731,927 higher, and traffic expenses £601,024 higher.

British Railway Capital, 1934

	£
Capital authorised	1,219,198,338
Capital created	1,145,898,995
Capital issued	1,126,639,828
Deduct balance of nominal additions and deductions ...	44,579,345
Capital issued (excluding nominal additions and deductions)	1,082,060,483
Add balance of premiums and discounts	33,896,256
Deduct calls in arrear and amount uncalled	26,031
Sinking fund debenture stock redeemed	100,000
Total capital receipts	1,116,030,708
Capital expenditure :—	
On railway	1,009,777,992
On road vehicles	3,767,088
On steamboats, &c.	9,289,073
On docks, harbours and wharves	71,945,140
On hotels	9,636,065
On electric power stations, &c.	3,319,777
Subscriptions to companies other than railway ...	11,746,893
Total capital expenditure ...	1,177,915,190
Capital expenditure in excess of capital receipts	61,884,482
Total capital powers and other assets available for future expenditure	24,943,112

Table of Revenue Receipts and Expenditure

	Year 1934			Year 1933		
	Gross receipts	Expenditure	Net receipts	Gross receipts	Expenditure	Net receipts
	£	£	£	£	£	£
Railway	155,578,960	126,783,018	28,795,942	149,642,627	123,122,760	26,519,867
Road transport ...	609,620	506,510	103,110	538,783	458,001	80,782
Steamboats ...	3,450,812	3,191,478	259,334	3,348,203	3,139,332	208,871
Canals	176,559	210,524	Dr. 33,965	168,191	210,504	Dr. 42,313
Docks, harbours, and wharves ...	6,593,619	6,068,913	524,706	6,349,678	5,953,328	396,350
Hotels, refreshment rooms, and cars...	5,365,114	4,804,495	560,619	5,048,092	4,599,675	448,417
Collection and delivery, parcels and goods ...	4,772,464	5,557,421	Dr. 784,957	4,474,550	5,147,053	Dr. 672,503
Other separate businesses ...	13,975	28,992	Dr. 15,017	9,045	15,196	Dr. 6,151
Total	176,561,123	147,151,351	29,409,772	169,579,169	142,645,849	26,933,320
Miscellaneous receipts (net) :—						
Rents (houses, lands, hotels, lump sum tolls, &c.)			3,558,781			3,550,877
Interest and dividends from investments in other undertakings			712,638			517,814
Transfer fees			25,235			24,594
General interest			1,072,680			1,144,097
Special items			520,913			421,257
Total net receipts			35,300,019			32,591,959
Deduct miscellaneous charges (interest on superannuation funds, chief rents, rent charges, rents of leased undertakings, &c.)			3,045,123			3,002,870
Net revenue for the year			32,254,896			29,589,089
Balance brought forward from last year's account			185,800			67,271
Special items			754,266			1,283,516
Appropriation from general reserve			50,540			50,125
Amount available for appropriation			33,245,502			30,990,001

MINISTRY OF TRANSPORT ACCIDENT REPORT

Two failures of engine No. 6167, L.M.S.R.; December 26 and 31, 1934

Included in the volume of railway accident reports for the three months ended December 31 last was one by Mr. J. L. M. Moore on two failures, in one week, of L.M.S. "Royal Scot" class locomotive 6167, the second of which involved injuries to the driver and fireman.

On December 31 Driver Linley and Fireman Wood were on engine No. 6167 working the 11.50 a.m. express passenger train from Euston to Manchester. They prepared the engine themselves and noticed nothing amiss until after passing Tring (31½ miles), when steam started to blow up between the front edge of the footboards and the back plate of the boiler. It gradually grew worse and on approaching Welton (70 miles), at a speed of about 60 m.p.h., there was a loud report and the footplate was suddenly enveloped in steam and water. Linley stopped the train by means of the vacuum brake with the regulator still open. His right arm and wrist were badly scalded in doing so. It was decided that Wood should go to Welton with a wrong line order for assistance, and on returning to the footplate for the wrong line order form his right arm was scalded. The engine was first taken to Rugby, but when it was found that one of the steadying bracket studs had blown out of the boiler back plate just below the level of the footplate it was sent to Crewe works for repair.

A similar failure of the same engine had occurred previously on December 26 when Driver Morcher and Fireman Aldridge were working the 1.30 p.m. passenger train from Euston to Carlisle. The stud came out of the same hole in the back plate when passing Madeley (150 miles), but in spite of the steam and water which was blowing into the cab Morcher was able to keep the train running until it reached Wrine Hill intermediate signal-box some two miles farther on. From that point it was dragged with the disabled engine to Crewe by an assisting engine, which had been taken on at Rugby owing to shortage of steam. As there had been no previous escape of steam from this stud, the enginemen concluded that a gauge glass had failed, and when groping for the gauge column clocks Aldridge received scalds on his left hand. Morcher was unhurt.

Engine No. 6167 left Crewe works after a general repair on November 13, 1934, during which the boiler was changed. The repaired boiler which was put in had been fitted with a new firebox, wrapper, and back plates. The steadying bracket on this class of engine is fixed to the centre of the back plate below the level of the footboards by eight 1-in. steam-tight studs, arranged in two horizontal rows. The steadying bracket is a steel casting with a flat base about 1¼ in. thick, with a projecting lug extending down the centre which fits between two angle brackets riveted to the drag-box front cross stay of the main frames. It carries no weight, but is intended to keep the boiler central between the frames and prevent any lateral movement while allowing for longitudinal expansion. It is an easy fit between the brackets, the intervening spaces being taken up by a stirrup iron which is fitted into position from above when the boiler has been centralised in the frames. The stirrup iron is held in position by two set bolts screwed into the top of the steadying bracket lug. The eight stud holes, which are 1-in. dia., are drilled in a machine after the back plate has been flanged. The tapping of the holes is carried out by hand later in the boiler mounting shop, after which steam-tight studs (1·008-in. dia. and 11 threads to the inch) are screwed in and lightly caulked.

When the engine returned to Crewe works after the second failure, Mr. Moore inspected the bracket before it or its fastenings had been touched. The bracket was loose and the stud was missing from the left inside bottom hole. The remaining studs, complete with nuts and split pins, were in position and tight in the holes of the back plate. In two instances, however, the washers which had been fitted behind the nuts had holes too small to pass beyond the threaded portion of the stud, and in consequence were tight on the body of the stud and were not touching the bracket. In another case, where there were no washers, the nut was screwed home on the stud, but was $\frac{3}{16}$ in. away from the bracket. Thus three of the eight nuts cannot at any time have been holding the bracket, and some of the remainder were only bearing unevenly upon it as the studs were not square with the plate owing to careless tapping of the holes. This irregularity of the studs had the further disadvantage of necessitating the enlarging of the holes in the bracket. Consequently once the steadying bracket started to work loose owing to the indifferent hold of the nuts the enlarged holes allowed considerable movement between it and the back plate of the boiler. This movement, which would be continuous when the engine was in motion, was, in Mr. Moore's opinion, the cause of the left inside bottom stud unscrewing gradually and coming out on December 26 when the engine had run 8,799 miles. As the stud which came out was the only one which received any attention at the running sheds, the bad workmanship described above must be attributed to Fitter H. C. Stubbs of the boiler mounting shop in Crewe works who was responsible for tapping the holes in the back plate and fixing the bracket. It also points to a very poor supervision on the part of the Leading Fitter E. Gartside and Foreman A. R. Lowe of the same shop.

When the engine failed on December 26 it was taken to Crewe North shed for attention. Foreman-fitter W. Nightingale examined the hole in the back plate on the following morning and, finding the threads good as far as he was able to judge by feeling, ordered a new stud from the works stores and gave instructions for it to be fitted. The work was carried out by Fitter T. J. Hulse, and when Mr. Moore tried the stud in the hole he found that he was able to screw it home by hand.

In spite of emphatic denials by Hulse, Mr. Moore has little doubt that he was responsible for the stud being reduced in diameter at the end which had to be screwed into the back plate in order to facilitate the work of fitting it. There is, on the other hand, the possibility that an undersized stud was issued by the stores in error, but in that case Hulse should have discovered that it was faulty, and rejected it.

Foreman-fitter Nightingale is not free from blame, as the fitting of a steam-tight stud in a position where it is impossible to make a proper inspection of the hole or use correct appliances for driving the stud is not work which should be undertaken in a running shed. Nightingale, in Mr. Moore's opinion, made a serious error of judgment in ordering it to be done, and a general instruction on the subject has already been issued for the guidance of the staff in future. The company has also agreed that the steadying brackets shall be riveted to the back plates of all new boilers and of repaired boilers where the nature of the repair permits.

Exports of Railway Material from the U.K. in July

	July, 1935	July, 1934	Seven Months Ending July, 1935	Seven Months Ending July, 1934
	£	£	£	£
Locomotives, rail	99,087	25,813	393,769	168,442
Carriages and wagons	97,595	84,816	635,396	432,064
Rails, steel	127,402	95,827	448,148	517,022
Wheels, sleepers, fishplates and miscellaneous materials	218,069	143,454	1,020,055	599,469

Locomotive and rail exports included the following :—

	Locomotives		Rails	
	July, 1935	July, 1934	July, 1935	July, 1934
	£	£	£	£
Argentina	—	15,336	6,012	8,410
Union of South Africa	—	—	108,416	22,704
British India	14,649	5,115	37,593	44,235

NOTES AND NEWS

Noise Reduction on the L.M.S.R.—To minimise the amount of noise at stations, the L.M.S.R. proposes to equip 510 platform luggage barrows with rubber tyres.

L.M.S.R. Locomotive "The Manchester Regiment."—The L.M.S.R. has arranged to name its locomotive No. 6148, of the Royal Scot type, *The Manchester Regiment.*

German Railway Interpreters.—One hundred Berlin officials of the German State Railway are taking intensive courses in one or more foreign languages in readiness for the Olympic Games in Berlin in August, 1936.

Another G.W.R. New Halt.—A new halt at Coole Pilate, between Audlem and Nantwich, was opened by the G.W.R., on Saturday last, August 17. All local trains on weekdays and Sundays call at the new halt, and the usual cheap ticket facilities are available.

The "Model Engineer" Exhibition.—Sir Josiah Stamp, Chairman and President of the Executive, L.M.S.R., supported by Mr. Sidney E. Garcke, President for 1934-5 of the Institute of Transport, will open the 17th "Model Engineer" Exhibition at the Royal Horticultural Hall, Westminster, on September 19.

Black Sea Railway.—A Reuters message dated August 16, indicates that by January 1 next all but 75 miles of the Black Sea Railway will have been completed. In spite of considerable engineering difficulties, the Otchemtchiri-Sukhum section along the coast will be finished by that date, the bridges already having been completed and platelaying being in hand. The whole line will reduce the distance between Moscow and Tiflis by over 400 miles.

The Invention of the Vortex Blast Pipe.—In our brief obituary, published last week, of Professor Henry Adams, it was stated that he was the inventor of the Adams Vortex blast pipe. Our attention has subsequently been called to the fact that most locomotive books credit Mr. William Adams, of the London & South Western Railway, with the invention. Actually both claims are correct, as it was the joint invention of Henry and William Adams, the patent, No. 11,047, having been taken out on September 17, 1885, in their joint names.

Railway Assessment Authority.—The report of the Railway Assessment Authority for the year ended March 31, 1935, states that during the year it succeeded in publishing the drafts of the four remaining parts of the first railway valuation roll, thus concluding the first stage in the valuation procedure laid down by the Act of 1930. Each of the five parts of the roll has to be completed and then revised, before the local valuation lists can be amended with retrospective effect to April, 1931. The authority completed the Southern Railway part of the roll early in the year, and just after the close of the year completed the part relating to the L.N.E.R. and heard representations upon the draft roll relating to the L.M.S.R.

New Catering Facilities at St. Pancras.—The L.M.S.R. has just completed a comprehensive scheme of enlargement and extension of the catering facilities at St. Pancras station, including a new grill room accommodating 120 people and the remodelling and redecoration of the café.

Mechanical Guides at German Stations.—Munich has installed a mechanical guide at the Central station. On a map of the town, enclosed in glass, threads are attached to the 120 principal sights of the city. On selecting the appropriate thread, the route from the railway station to the desired place is lit up on the map. A similar guide is also in use at Potsdam Central station near Berlin.

Reduced Rates for Southern Railway Camping Coaches.—The Southern Railway has arranged that, beginning on September 28, the charge for hiring camping coaches will be £2 10s. a week. Every convenience for six persons, from cruet to corkscrew, will be provided as hitherto. The coaches are occupying sites amongst the most beautiful of South of England scenery, including Devon, Cornwall, and the New Forest.

A Notable L.N.E.R. Locomotive.—The L.N.E.R. has just broken up at Stratford works a veteran locomotive, No. 7930, which was distinguished in that it was erected in the record time of 9¾ hours. The engine was then numbered No. 930 and was of the six-coupled goods type. The record erection took place on December 11, 1891, and was intended to demonstrate how quickly a locomotive could be put together. Since that date this locomotive has accomplished a mileage of 1,127,750 and its recent withdrawal is due to the fact that the class has now become obsolete.

The Lynton & Barnstaple Railway.—The Southern Railway Company has issued the following notice: "Make sure of a trip this holiday over the romantic light railway between Barnstaple and Lynton, through the beautiful scenery of the miniature alps of North Devon, along the edge of Exmoor. This line will be closed after September 29, 1935." The Southern Railway has also issued the following historical note: "The Lynton & Barnstaple Railway was opened on May 16, 1898, under the Lynton and Barnstaple Railway Act, 1895. It extends from Barnstaple to Lynton, a distance of 19¼ miles, and the district through which it runs is reputed to contain some of the finest scenery in England. The gauge of the line is only 1 ft. 11½ in., and the locomotive and rolling stock consist of four engines, 17 coaches, and 24 freight vehicles. The line was vested in the Southern Railway from July 1, 1923, under the Southern Railway Act, 1923, not under the Railways Act, 1921."

New Late Services for Yachtsmen.—The Southern Railway has arranged new late return services to London on Sundays for the convenience of yachtsmen. The services which leave Yarmouth (Isle of Wight) at 7.45 p.m., Cowes, 7.55, Lymington Pier 8.20 and Southampton Central 9.12 p.m., give an arrival time at Waterloo at 10.54 p.m. Corridor and dining car facilities are provided.

C.L.C. Station for Football Ground.—In readiness for the football season, the Cheshire Lines Committee has erected a new station at Trafford Park Junction, to be called United Football Ground after the Manchester club whose ground it serves. There is one platform, served by a loop off the up main line. Six turnstile gates have been provided. The new station adjoins the ground, whereas Trafford Park, hitherto the nearest station, is 1¼ miles away.

Berlin Underground Collapse.—A 250-ft. length of the side of the tunnel now under construction for the Berlin Nord-Sud underground railway collapsed near the Brandenburg Gate on August 20, burying a number of workmen, and carrying with it a crane and other machinery. At noon on August 21 it was officially stated that the number of missing was 20. At the point where the accident occurred the works are unusually deep; the tunnel had been covered in and trams were running over it.

New Swiss Electric Stock.—The Berne-Lötschberg-Simplon Railway has acquired five 250 h.p. light-weight motor coaches for fast service over its 15,000-volt single-phase system. Some of the cars have 92 seats, with standing room for 24 persons, and the others have 65 seats and 50 standing places. The lightest cars tare 27 tons, and can be used for trailer haulage up to a total train weight of 70 tons. It is intended to reduce the time between Brig and Thun (53½ miles) to 73-75 min. with these motor-coaches, in place of the 98-110 min. (including two stops) of the trains hauled by electric locomotives.

Federation of Enginemen's Mutual Improvement Classes.—The first conference of the Federation of Enginemen's Mutual Improvement Classes was held at the Merchant Venturers' Technical College, Bristol, on August 11. Delegates from the four main line groups were present and the discussions hinged on technical advancement and efficiency among railway enginemen, which is the aim of the Federation. A display of books, dia-

grams and models was given, including a championship model of *King George V* worth £175, and Stephenson and Walschaert valve-gear models for instructional purposes. The Federation has always advised Mutual Improvement classes to take in *The Railway Magazine* regularly, in order to keep informed of the latest developments at home and abroad, and this magazine was, of course, on view. Next year's conference is to be held at the Science Museum, London, on the fourth Sunday in September. The Hon. Secretary is Engineman A. King, G.W.R. Locomotive Dept., Banbury.

Modernisation of Carlisle L.N.E.R. Locomotive Depot.—A complete scheme of modernisation is to be put in hand by the L.N.E.R. at the Canal locomotive depot at Carlisle. A locomotive coaling plant of 200 tons capacity is being installed, together with the latest pattern sand dryer. A wheel drop pit is being put in which will greatly accelerate the progress of locomotive repairs; the scheme includes the provision of a new engine pit 135 ft. in length and to facilitate the introduction of new working arrangements the layout of the yard is to be considerably altered. For the past two years all the L.N.E.R. locomotives working from Carlisle have been stabled at this important shed, and it is a pleasant feature of the new scheme that provision has been made for new mess rooms for the engine drivers, firemen, and cleaners who are responsible for the work at this depot.

Road Accidents.—The Ministry of Transport return for the week ended August 17, 1935, of persons killed or injured in road accidents is as follows. The figures in brackets are those for the corresponding period of last year:—

	Killed, including deaths resulting from previous accidents	Injured
England ...	... 116 (127)	4,350 (4,630)
Wales ...	... 6 (10)	245 (262)
Scotland ...	... 16 (18)	477 (488)
	138 (155)	5,072 (5,380)

The total fatalities for the previous week were 161, as compared with 160 for the corresponding period of last year.

British and Irish Traffic Returns

GREAT BRITAIN	Totals for 33rd Week			Totals to Date		
	1935	1934	Inc. or Dec.	1935	1934	Inc. or Dec.
	£	£	£	£	£	£
L.M.S.R. (6,925½ mls.)						
Passenger-train traffic...	664,000	662,000	+ 2,000	16,307,000	15,903,000	+ 404,000
Merchandise, &c. ...	429,000	430,000	− 1,000	14,540,000	14,476,000	+ 64,000
Coal and coke ...	221,000	219,000	+ 2,000	7,415,000	7,412,000	+ 3,000
Goods-train traffic ...	650,000	649,000	+ 1,000	21,955,000	21,888,000	+ 67,000
Total receipts	1,314,000	1,311,000	+ 3,000	38,262,000	37,791,000	+ 471,000
L.N.E.R. (6,336 mls.)						
Passenger-train traffic...	436,000	429,000	+ 7,000	10,537,000	10,244,000	+ 293,000
Merchandise, &c. ...	293,000	302,000	− 9,000	10,072,000	10,083,000	− 11,000
Coal and coke ...	222,000	224,000	− 2,000	7,202,000	7,395,000	− 193,000
Goods-train traffic ...	515,000	526,000	− 11,000	17,274,000	17,478,000	− 204,000
Total receipts	951,000	955,000	− 4,000	27,811,000	27,722,000	+ 89,000
G.W.R. (3,750 mls.)						
Passenger-train traffic...	293,000	291,000	+ 2,000	6,820,000	6,706,000	+ 114,000
Merchandise, &c. ...	166,000	172,000	− 6,000	5,892,000	5,834,000	+ 58,000
Coal and coke ...	96,000	102,000	− 6,000	3,188,000	3,219,000	− 31,000
Goods-train traffic ...	262,000	274,000	− 12,000	9,080,000	9,053,000	+ 27,000
Total receipts	555,000	565,000	− 10,000	15,900,000	15,759,000	+ 141,000
S.R. (2,171 mls.)						
Passenger-train traffic...	422,000	402,000	+ 20,000	9,974,000	9,674,000	+ 300,000
Merchandise	61,000	67,000	− 6,000	1,986,500	2,105,000	− 118,500
Coal and coke ...	28,000	29,000	− 1,000	962,500	1,008,000	− 45,500
Goods-train traffic ...	89,000	96,000	− 7,000	2,949,000	3,113,000	− 164,000
Total receipts	511,000	498,000	+ 13,000	12,923,000	12,787,000	+ 136,000
Liverpool Overhead ... (6½ mls.)	1,426	1,368	+ 58	39,166	37,964	+ 1,202
Mersey (4½ mls.) ...	3,744	3,607	+ 137	132,855	135,542	− 2,687
*London Passenger Transport Board ...	518,700	502,700	+ 16,000	3,788,800	3,704,800	+ 84,000
IRELAND.						
Belfast & C.D. pass. (80 mls.)	3,282	3,268	+ 14	85,937	84,923	+ 1,014
,, ,, goods	443	447	− 4	16,490	17,045	− 555
,, ,, total	3,725	3,715	+ 10	102,427	101,968	+ 459
Great Northern pass. (543 mls.)	15,700	14,550	+ 1,150	349,750	328,800	+ 20,950
,, ,, goods	8,900	8,050	+ 850	297,750	282,600	+ 15,150
,, ,, total	24,600	22,600	+ 2,000	647,500	611,400	+ 36,100
Great Southern pass. (2,124 mls.)	38,278	36,176	+ 2,102	809,799	792,798	+ 17,001
,, ,, goods	31,445	32,185	− 740	1,115,673	1,042,553	+ 73,120
,, ,, total	69,723	68,361	+ 1,362	1,925,472	1,835,351	+ 90,121

* 7th week, the receipts for which include those undertakings not absorbed by the L.P.T.B. in the corresponding period last year; last year's figures are, however, adjusted for comparative purposes

British and Irish Railways Stocks and Shares

Stocks	Highest 1934	Lowest 1934	Prices Aug. 21, 1935	Prices Rise/Fall
G.W.R.				
Cons. Ord. ...	66½	48½	48½*	−2
5% Con. Prefce. ...	118	109	119½*	−2
5% Red. Pref. (1950)	115	107	111½*	—
4% Deb.	117	105	115	−½
4½% Deb. ...	119	109	117½	+2
4½% Deb. ...	129½	115¼	127½	—
5% Deb.	135	126¼	138½	—
2½% Deb.... ...	75	64	78	—
5% Rt. Charge ...	134 7/16	123¼	135½	−1
5% Cons. Guar. ...	132¾	121¾	133*	−1
L.M.S.R.				
Ord.	30½	19½	19	−2
4% Prefce. (1923)	64¼	41	53	−3
4% Prefce. ...	87	69½	82*	−2
5% Red. Pref. (1955)	107	92½	102½*	−1
4% Deb.	114⅛	100½	106½	−1
5% Red. Deb. (1952)	118 11/16	111¼	115½	—
4% Guar.... ...	106½	96¾	102*	−1
L.N.E.R.				
5% Pref. Ord. ...	24¾	13½	10½	−¾
Def. Ord.	11½	6⅞	5½	−⅝
4% First Prefce....	76	59½	59	−3
4% Second Prefce.	47	25½	22	−2½
5% Red. Pref. (1955)	94½	80	81½	−2
4% First Guar. ...	104	92	99*	−1
4% Second Guar.	97⅞	86½	92*	−2
3% Deb.	90	74½	81½	−½
4% Deb.	114	99¼	105½	−½
5% Red. Deb. (1947)	117	108	113½	—
4½% Sinking Fund Red. Deb.	111¼	105¼	110	—
SOUTHERN				
Pref. Ord.... ...	90	63⅛	81*	−2
Def. Ord. ...	32⅝	19	20½	1½
5% Prefce. ...	118 3/16	107½	119½	−2
5% Red. Pref. (1964)	115¾	107½	114½	—
5% Guar. Prefce.	132	120¾	133½*	—
5% Red. Guar. Pref. (1957)	119⅛	113	117½*	—
4% Deb.... ...	116½	103¼	114½	—
5% Deb.	134	124 13/16	136½	—
4% Red. Deb. 1962–67	113 11/16	105 9/16	113½	—
BELFAST & C.D.				
Ord.	6	5	4	—
FORTH BRIDGE				
4% Deb.	110	100	108½	—
4% Guar. ...	110	100	107½	—
G. NORTHERN (IRELAND)				
Ord.	9¾	4 15/16	14	—
G. SOUTHERN (IRELAND)				
Ord.	25	12½	32	—
Prefce.	21½	13 15/16	46	—
Guar.	48	39	78	+3
Deb.	67	59	80	—
L.P.T.B.				
4½% "A" ...	126	115	124½	—
5% "A" ...	135½	124½	134½	—
4½% "T.F.A." ...	113½	107½	111	—
5% "B" ...	131¾	118	127½	—
"C"	97	73	100	—
MERSEY				
Ord.	15¼	7	12	—
4% Perp. Deb. ...	93½	82½	94½	—
3% Perp. Deb. ...	66½	61½	70½	—
3% Perp. Prefce.	54	44½	52½	—

* ex dividend

CONTRACTS AND TENDERS

Alfol Insulation Limited has received an order for sets of Alfol boiler insulation required for 25 2-6-0 locomotives which, as announced in this column of our issue of March 15 are part of an order building by the North British Locomotive Co. Ltd. for the Egyptian State Railways.

L.M.S.R. Road Transport Vehicle Orders

The L.M.S.R. has placed the following orders for road transport vehicles: Scammell Lorries Limited: 100 three-ton van tractors; Metropolitan-Cammell-Weymann Motor Bodies Limited: 155 13 ft. by 6 ft. flat platform 3-ton trailers and 55 15 ft. by 6 ft. flat platform 3-ton trailers. The bodies for these trailers will be built by the Metropolitan-Cammell Carriage & Wagon Co. Ltd. In addition, the L.M.S.R. is to construct 77 3-ton trailers at Wolverton works.

The Fairfield Shipbuilding & Engineering Co. Ltd. has received an order from the L.M.S.R. for the supply of a twin-screw turbine steamer, with an overall length of 230 ft., for service on the River Clyde.

Chinese Locomotives and Coaches

The orders foreshadowed in last week's issue of THE RAILWAY GAZETTE for locomotives and coaches for the Canton-Hankow Railway to the order of the Chinese Government Purchasing Commission, on behalf of the Ministry of Railways, China, and under the inspection of Messrs. Sandberg, have now been confirmed. Full details were given in our issue last week, including dimensions of the locomotives, the firms concerned being the Vulcan Foundry Co. Ltd. and the Birmingham Railway Carriage & Wagon Co. Ltd., but it may be added that the coaches are to be of all-steel construction with lifting type windows, will be fitted with Isothermos axleboxes, Stone's lighting, Westinghouse braking and Vapor heating; and that the cylinder diameter of the locomotives has now been increased by 10 mm. to 540 mm. (21¼ in.), as compared with the earlier engines of the class built by the Vulcan Foundry for the same railway.

Electric Rolling-stock, L.N.E.R.

As announced in our issue of August 9, the L.N.E.R. has decided to modernise the North Tyneside electrified lines and also to electrify the line between Newcastle-on-Tyne and South Shields, and has ordered the new rolling stock from the Metropolitan-Cammell Carriage & Wagon Co. Ltd., while the contract for the complete electrical equipment of the rolling stock has been placed with the Associated Manufacturers of Electric Traction Equipment Limited, a company in which the following firms are jointly interested: British Thomson-Houston Co. Ltd., Crompton Parkinson Limited Allen, West & Co. Ltd., English Electric Co. Ltd., General Electric Co. Ltd., and Metropolitan-Vickers Electrical Co. Ltd. It has now been decided that this contract will be carried out by Crompton Parkinson Limited as principal sub-contractor in conjunction with Allen West & Co. Ltd. and the British Thomson-Houston Co. Ltd. The contract covers the supply and installation of 64 articulated two-car units equipped with two motors, a number of four-motor vans and coaches, together with the control equipment and heating and lighting equipment, as well as the re-equipment of a number of existing vehicles.

Experimental Locomotives for India

Caprotti Valve Gears Limited is to supply sets of Caprotti poppet valve gear for the two XP class 4-6-2 broad-gauge locomotives which, as recorded in this column in our issue of last week, are to be built for the Great Indian Peninsula Railway by the Vulcan Foundry Co. Ltd. These engines, which, as their classification indicates, are experimental, will have A.C.F.I. feed-water heaters and pumps. Roller bearings to all axle journals on both engines and tenders will be fitted, Skefko in one case and Timken in the other. On one engine roller bearings will be used for the connecting and coupling rods. The boiler pressure is to be 210 lb. per sq. in. in both cases. Messrs. Rendel, Palmer & Tritton are the consulting engineers.

Siemens Bros. & Co. Ltd. has received an order from the Chinese Government Purchasing Commission, to the inspection of Messrs. Fox & Mayo, for a quantity of telephone materials.

Boilers for Egypt

The Vulcan Foundry Co. Ltd. has received orders from the Egyptian State Railways Administration for seven superheated boilers for standard-gauge 4-6-0 express locomotives.

The Egyptian State Railways Administration has placed the following orders :—

Steel Peech & Tozer Limited: Piston rods (Ref. E.S.R. 13,300, £251 1s. 9d.).
Connolly Bros. Ltd.: Leather (Ref. E.S.R. 43,249, £359 3s. 4d.).
Uddeholms: Boiler tubes (Ref. E.S.R. 317 G3/5, £5,517 free delivery).
Fried. Krupp A.G.: Round mild steel (Ref. E.S.R. 301 G3/13, £4,471).
J. H. Peck & Co. Ltd.: Canvas (Order No. 43,251, £488 10s.).

The English Steel Corporation has received an order to the inspection of Messrs. Rendel Palmer & Tritton for 126 carriage and wagon axles for the Bikaner State Railway.

The Bombay Baroda & Central India Railway Administration has placed the following orders to the inspection of Messrs. Rendel Palmer & Tritton :—

Carters (Merchants) Limited on behalf of Skoda Works: 640 carriage and wagon axles.
John Spencer & Sons Limited: 324 carriage and wagon axles.
Geo. Turton Platt Limited: 480 wagon buffers.
Henricot Steel Foundry: 320 wagon axleboxes.

The Egyptian Ministry of Public Works (Delta Barrage Directorate) is calling for tenders, to be presented in Cairo by October 5, for the supply of 1,000 metres of decauville rails and accessories, and 1,000 sleepers. Further details can be obtained from the Department of Overseas Trade.

Locomotive Enquiries

We understand that the Siamese State Railways Administration is shortly to issue enquiries for the supply of eight Pacific- and two Garratt-type locomotives.

It is reported that the Western Australian Government is considering proposals for expending £35,000 on new plant and machinery required for railway workshops.

Tenders are invited by the Bengal & North Western Railway, receivable at 237, Gresham House, Old Broad Street, London, E.C.2 by September 3, for 400 pairs of wheels and axles for wagons.

The Chinese Government Purchasing Commission is inviting tenders from British manufacturers only for 33 bogie carriage underframes. Tender forms can be obtained from Messrs. Sandberg, 40, Grosvenor Gardens, London, S.W.1.

Soviet Orders in Great Britain

The orders placed in Great Britain by Soviet trading organisations in June of this year amounted to £607,171 as compared with £782,185 in the corresponding month in 1934. In the first half of this year the orders placed and purchases made amounted to £4,524,631 as compared with £4,980,213 in the corresponding period of the preceding year, a decrease of about 9 per cent. The following table shows the principal orders placed for engineering materials in the period under consideration :—

	June, 1935	June, 1934	Jan.–June, 1935	Jan.–June, 1934
	£	£	£	£
Machinery and Equipment ..	112,451	315,159	1,040,409	773,496
Ferrous alloys and steel ..	53,277	33,095	446,296	824,098
Non-ferrous metals ..	237,039	17,912	1,123,606	1,140,501
Rubber ..	62,201	325,284	275,230	1,145,481

As can be seen, the orders for machinery and equipment have shown an increase this year of nearly 35 per cent. There was a serious drop in the orders for ferrous alloys and steel and a particularly large decrease in the purchase of rubber.

Big Railway Equipment Order in America

Contracts for railway equipment exceeding $2,000,000 in value have been awarded to the Westinghouse Electric & Manufacturing Company by the Board of Transportation of New York City, calling for accessories for new underground railway cars ordered for city-operated lines, states a Reuters message. The cars will be built by the American Car & Foundry Company, the Pullman-Standard Car Manufacturing Company, and the Pressed Steel Car Company. Five hundred new cars have been ordered, to increase equipment

OFFICIAL NOTICES

Bengal-Nagpur Railway Co. Ltd.

THE Directors are prepared to receive tenders for :—

(A) 1,200 Steel Tyres for carriages and wagons.
(B) 1,500 Drawbars.
(C) 1-10 ton Steam Travelling Crane.

Specifications and forms of tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad Street, London, E.C.2, on or after Monday, 12th of August, 1935.

A fee of 20s. will be charged for each copy of the specification "A" and 10s. for each copy of the specifications "B" and "C," which is NOT returnable.

Tenders must be submitted not later than NOON on Thursday, 5th September, 1935.

The Directors do not bind themselves to accept the lowest or any tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
P. W. GIBBS,
Assistant Secretary.

The Bengal and North Western Railway Co. Ltd.

THE Directors are prepared to receive tenders for the supply of :—
400 PAIRS WHEELS AND AXLES FOR WAGONS.
as per specification to be seen at the Company's Offices.

Tenders addressed to the undersigned, and envelope marked "Tender for Wheels and Axles," with name of firm tendering, to be lodged not later than NOON on the 3rd day of September, 1935.

For each specification a fee of £1 will be charged which cannot, under any circumstances, be returned.

The Directors do not bind themselves to accept the lowest or any tender.

By order of the Board,
W. R. IZAT,
Managing Director.

237, Gresham House,
Old Broad Street,
London, E.C.2.
15th August, 1935.

The Chinese Government Purchasing Commission

THE Commission is prepared to receive Tenders from British manufacturers only for the supply of :—
33 BOGIE CARRIAGE UNDERFRAMES.

Tender documents can be obtained at the office of the Consulting Engineers, MESSRS. SANDBERG, 40, Grosvenor Gardens, London, S.W.1.

A non-returnable fee of £2 will be charged for a set of documents.

OFFICIAL ADVERTISEMENTS.

OFFICIAL ADVERTISEMENTS intended for insertion on this page should be sent in as early in the week as possible. The latest time for receiving official advertisements for this page for the current week's issue is noon on Thursday. All advertisements should be addressed to :—*The Railway Gazette*, 33, Tothill Street, Westminster, London, S.W.1.

and extend services on the Eighth Avenue and connecting subway lines. The Westinghouse company will supply 190-h.p. traction motors for multiple-unit control for operation of eight-to-ten-unit trains, battery charging panels and over 2,000 car-ventilating fans.

Diesel Railcar for Ireland

Walker Brothers (Wigan) Limited has received an order for the engine, power bogie, hydraulic coupling and gearbox, &c., required for an articulated two-coach diesel railcar for the Great Northern Railway of Ireland. The order includes Gardner 153-b.h.p. heavy oil engine; Hydraulic Coupling & Engineering Co. Ltd. hydraulic coupling; and Self Changing Gears Limited preselective gearbox. The outer bogies, underframe for one coach and bodywork will be carried out by the railway company. The articulated unit will have accommodation for 160 passengers.

The Indian Stores Department is calling for tenders, to be presented in Simla by September 24, for the supply of a 2 ft.-gauge diesel locomotive. Additional particulars can be obtained from the Department of Overseas Trade.

The L.N.E.R. is proposing to order two petrol-driven tractors for service in the goods yard, wharf, and on the quayside at Ipswich. The tractors will be specially adapted for wagon shunting operations and will be capable of hauling or propelling five loaded wagons or six empty wagons at a time.

The South African Railways & Harbours Administration is calling for tenders, to be presented in Johannesburg by September 16, for the supply and delivery of 15 battery elevating platform trucks. Firms desirous of offering battery trucks of United Kingdom manufacture can obtain further details from the Department of Overseas Trade.

RAILWAY AND OTHER REPORTS

Fishguard and Rosslare Railways and Harbours.—The report for the half year to June 30, 1935, shows an amount of £39,547 received under guarantee of the Great Western and Great Southern Railways. Deducting £117 for fees and other charges leaves £39,430 to be carried to net revenue account. Interest on the 3½ per cent. debenture stock takes £13,904; on the 3½ per cent. new guaranteed preference stock £21,659; and on the 3½ per cent. new preference stock (1914) £3,867.

Letterkenny Railway.—The half year to December 31, 1934, shows that in the half year ended December 31, 1933, net revenue was £1,211, against £917 in the corresponding period of 1932. The Letterkenny Railway Company was incorporated by Act of July 3, 1860, but all the rights and powers of the directors are vested in the Commissioners of Public Works, who took possession of the line on December 17, 1887. The 16½ miles of 3-ft. gauge line is worked under agreement by the Londonderry & Lough Swilly Railway Company.

Bolivar Railway Company.—Gross receipts for the year ended December 31, 1934, including those of the Puerto Cabello and Valencia railway (worked by the company), were £70,068, and expenses £66,544. To the resultant balance of £3,524 was added £12,134 accruing from interest on investments, rent, exchange profit on remittances, &c., but deducting £35,419 for payment of interest on loans and unpaid debentures, rental of the Puerto Cabello Railway, and income tax, left a deficit of £23,285. This compared with a deficit last year of £33,255. The accumulated debit balance to go forward on revenue account now becomes £226,238. More passengers were carried during the year, a railcar service having won back much of the previous loss to buses, but fare reductions necessitated by road competition restricted the increase in receipts from the traffic to £456. Goods rates were also lowered, and despite a better tonnage, revenue from this source fell by £3,321. The working profit on the two railways of £3,524 was the result of a further limitation of expenditure, and compared with a working loss of £495 in 1933.

Chilean Northern Railway Company.—Gross receipts of this company, which is controlled by the Antofagasta (Chili) and Bolivia Railway Company, totalled £45,444 in 1934, increasing by £17,713, or 63·9 per cent. The number of passengers carried rose by 6,903, or 49·8 per cent. There was an advance of 8,954 tons, to a total tonnage for the year of 19,315, in merchandise.

Franco-Ethiopian Railway.—The report for 1934 of the French Chemin de Fer Franco-Ethiopien which runs from the French port of Djibouti to Addis Ababa, the capital of Abyssinia, a distance of 485 miles, shows a net profit of fr. 7,137,000, against fr. 7,324,960 for 1933, and fr. 9,803,000 in 1932. The dividend declared for 1934 is fr. 166, against fr. 125 for the five previous years. Construction was begun in 1900 by the Compagnie Imperiale des Chemins de fer Ethiopiens, but that company was taken over by the present one, which holds a concession for 99 years from 1917 when the line was completed. The capital is fr. 17,300,000 in shares of fr. 500 each. The railway is of metre gauge, and about 99 miles of it are in French Somaliland.

Hurst, Nelson & Co. Ltd.—The board proposes to pay an ordinary dividend of 3¾ per cent., less tax, the same as last year.

Railway Share Market

The stock and share markets have reflected in almost every department the unrest created by the breakdown of the Triple Power Conference in Paris Although a war between Italy and Abyssinia may not have the most remote connection with traffic between, say, Crewe and London or London and Scarborough, the tendency was for the Stock Exchange dealers to mark down prices of most stocks in the home railway market. The usual explanation for this procedure was given, namely, that it is for the protection of holders and to discourage panicky sales.

There are not a few investors who suspect that the procedure enables the market dealers to secure stock at a price which the public would be only too glad to pay. Notwithstanding this marking down in quotations the tendency was not in any sense panicky and buyers were about for stock at the lower level. Unfortunately, the traffic announcements made on Wednesday did not contribute towards an improvement in tendency as the market had been anticipating a substantial increase in nearly every group and this was not realised. The chief falls were in the prior lien stocks, but when there was evidence of strong bidding for British Government stocks the movement imparted a stronger tone to home railway fixed interest-bearing stocks. Among passenger stocks London Transport Board "C" stock moved up once more to par on dividend expectations. The report and accounts are to be submitted not later than October 31 next, and on the 3rd of that month the board will decide the rates of interest to be paid. An interim dividend of 1½ per cent. on the "C" stock was made last February, and the Stock Exchange is hoping that for the full year to June 30 last this will be made up to 3½ per cent. and possibly 4½ per cent. The maximum dividend allowed for the two years to June 30 last is 5 per cent. p.a., but as from July 1 last the standard rate payable rises to 5½ per cent. p.a.

Argentine Railway stocks showed improvement on the circulation of more hopeful views about dividend payments on preference and debenture stocks. The difficulty of making comparison between current receipts and those of a year ago, owing to the change in calculating sterling value of the peso, still causes much misapprehension among investors as to the position.

Traffic Table of Overseas and Foreign Railways Publishing Weekly Returns

	Railways	Miles open 1934-35	Week Ending	Traffics for Week: Total this year	Traffics for Week: Inc. or Dec. compared with 1934	No. of Weeks	Aggregate Traffics to Date: Totals: This Year	Aggregate Traffics to Date: Totals: Last Year	Aggregate Traffics to Date: Increase or Decrease	Shares or Stock	Prices: Highest 1934	Prices: Lowest 1934	Prices: Aug. 21, 1935	Yield % (See Note)
				£	£		£	£	£					
South & Central America.	Antofagasta (Chili) & Bolivia	830	18.8.35	13,400	— 1,850	33	405,890	450,300	— 44,410	Ord. Stk.	26 3/4	19	19 1/2	Nil
	Argentine North Eastern ..	753	17.8.35	8,074	+ 654	7	55,393	54,382	+ 1,011	,,	11	6 7/8	6	Nil
	Argentine Transandine ..	111	—	—	—	—	—	—	—	A. Deb.	52	45	48	85/16
	Bolivar	174	July, 1935	5,300	+ 200	30	44,700	43,850	+ 850	6 p.c. Deb.	10	6 1/2	10	Nil
	Brazil	—	—	—	—	—	—	—	—	Bonds.	13 3/4	10 7/16	13	3 15/16
	Buenos Ayres & Pacific ..	2,806	17.8.35	70,346	+ 1,462	7	506,403	492,615	+ 13,788	Ord. Stk.	16 1/2	8 1/2	7 1/2	Nil
	Buenos Ayres Central ..	190	27.7.35	$128,300	+ $2,200	4	$490,100	$509,200	— $19,100	Mt. Deb.	23	10	16	Nil
	Buenos Ayres Gt. Southern	5,085	17.8.35	121,433	+ 2,694	7	797,878	871,162	— 73,284	Ord. Stk.	35	22	20 1/2	Nil
	Buenos Ayres Western ..	1,930	17.8.35	41,574	— 4,696	7	280,433	314,515	— 34,082	,,	27 1/2	18 1/2	16	Nil
	Central Argentine	3,700	17.8.35	109,592	— 18,881	7	840,924	916,754	— 75,830	,,	23	13 1/2	11 1/2	Nil
	Do.	—	—	—	—	—	—	—	—	Dfd.	14	7	7	Nil
	Cent. Uruguay of M. Video	273	17.8.35	7,542	— 7,497	7	58,810	115,517	— 56,707	Ord. Stk.	15 1/2	3	4 1/2	Nil
	Do. Eastern Extn.	311	17.8.35	1,173	— 34	7	9,153	10,076	— 893	—	—	—	—	—
	Do. Northern Extn.	185	17.8.35	929	+ 109	7	7,746	5,895	+ 1,851	—	—	—	—	—
	Do. Western Extn.	211	17.8.35	659	+ 96	7	4,536	3,982	+ 554	—	—	—	—	—
	Cordoba Central	1,218	17.8.35	30,950	— 860	7	236,270	247,590	— 11,320	Ord. Inc.	6	3	2	Nil
	Costa Rica	188	30.6.35	15,519	— 4,778	52	191,757	218,120	— 26,363	Stk.	30 3/4	23 1/2	34	5 7/8
	Dorada	70	July, 1935	13,600	+ 3,600	30	80,400	70,200	+ 10,200	1 Mt. Db.	103	95	102 1/2	5 7/8
	Entre Rios	810	17.8.35	12,642	+ 2,243	7	83,852	73,404	+ 10,448	Ord. Stk.	21 1/2	12	10	Nil
	Great Western of Brazil ..	1,082	17.8.35	4,900	— 900	33	247,400	249,500	— 2,100	Ord. Sh.	7/8	5/8	1/2	Nil
	International of Cl. Amer...	794	June, 1935	$371,547	+ $118,226	26	$2,632,185	$2,719,993	— $87,808	—	—	—	—	—
	Interoceanic of Mexico ..	—	—	—	—	—	—	—	—	1st Pref.	1/–	1/–	1/2	Nil
	La Guaira & Caracas ..	22 3/4	July, 1935	3,725	— 730	30	27,570	25,890	+ 1,680	Stk.	12 3/4	7 5/8	8 1/2	Nil
	Leopoldina	1,918	17.8.35	21,055	— 13,837	33	549,799	693,425	— 143,626	Ord. Stk.	14 5/8	7	3 1/2	Nil
	Mexican	483	14.8.35	$237,600	+ $19,000	7	$1,572,400	$1,445,700	+ $126,700	,,	3 1/4	1 1/2	1/2	Nil
	Midland of Uruguay ..	319	July, 1935	5,218	— 4,243	4	5,218	9,461	— 4,243	,,	1 1/2	1/2	1 1/2	Nil
	Nitrate	401	15.8.35	4,805	— 506	32	93,610	90,541	+ 3,069	Ord. Sh.	3 29/32	51/–	2 1/2	Nil
	Paraguay Central	274	10.8.35	$1,424,000	+ $467,000	6	$9,768,000	$5,888,000	+ $3,880,000	Pr. Li. Stk.	84	67	77	7 15/16
	Peruvian Corporation ..	1,059	July, 1935	73,813	+ 21,196	4	73,813	52,617	+ 21,196	Pref.	14 1/2	8	9	Nil
	Salvador	100	10.8.35	¢12,293	+ ¢566	6	¢77,641	¢63,768	+ ¢13,873	Pr. Li. Db.	75	70	65	7 11/16
	San Paulo	153 1/2	11.8.35	21,907	— 4,238	32	817,336	886,292	— 68,956	Ord. Stk.	86	67	39 1/2	6 5/8
	Taltal	164	July, 1935	2,525	— 103	4	2,525	2,628	— 103	Ord. Sh.	2 1/8	1 7/16	1 1/2	6 11/16
	United of Havana	1,365	17.8.35	19,418	+ 2,615	7	130,930	122,244	+ 8,686	Ord. Stk.	6	2	2	Nil
	Uruguay Northern	73	July, 1935	612	— 444	4	612	1,056	— 444	Deb. Stk.	6 1/4	3	4 1/2	Nil
Canada.	Canadian National	23,734	14.8.35	590,943	+ 24,933	32	20,227,889	19,841,138	+ 386,751	—	—	—	—	—
	Canadian Northern ..	—	—	—	—	—	—	—	— 4 p.c.	Prep. Dbs.	78 1/4	51 1/2	55 1/2	7 5/16
	Grand Trunk	—	—	—	—	—	—	—	—	4 p.c. Gar.	104 1/2	97 1/4	101 1/2	3 15/16
	Canadian Pacific	17,211	14.8.35	455,200	+ 2,200	32	14,467,600	14,515,800	— 48,200	Ord. Stk.	18 5/16	11 1/16	11	Nil
India.†	Assam Bengal	1,329	31.7.35	33,090	— 7,805	18	394,697	477,062	— 82,365	Ord. Stk.	88 1/2	72	83 1/2	3 9/16
	Barsi Light	202	20.7.35	6,495	+ 1,028	16	50,887	51,997	— 1,110	Ord. Sh.	10 4 1/2	9 8 3/4	8 8 1/2	6 7/16
	Bengal & North Western ..	2,114	31.7.35	66,742	+ 1,974	17	889,642	925,465	— 35,823	Ord. Stk.	29 7 1/2	26 2	29 9 1/2	5 5/16
	Bengal Dooars & Extension	161	20.7.35	3,422	— 919	16	36,128	40,601	— 4,473	,,	12 5 1/4	12 4	12 5 1/2	5 9/16
	Bengal-Nagpur	3,268	10.7.35	156,075	+ 7,902	14	1,803,200	1,734,346	+ 68,854	,,	10 5 1/2	9 6	10 2 1/2	3 7/8
	Bombay, Baroda & Cl. India	3,072	10.8.35	172,275	+ 4,950	19	2,909,250	2,924,700	— 15,450	,,	11 5	10 8 1/2	11 3 1/2	5 5/16
	Madras & South'n Mahratta	3,230	20.7.35	134,250	— 19,415	16	1,709,026	1,906,523	— 197,497	,,	13 1	12 2 3/4	12 2 1/2	7 3/4
	Rohilkund & Kumaon ..	546	31.7.35	10,076	— 1,215	17	170,132	178,710	— 8,578	,,	26 3	25 0	29 2 1/2	5 1/2
	South India	2,526	20.7 35	112,465	+ 2,991	16	1,278,503	1,303,712	— 25,209	,,	11 9	11 5	11 7 1/2	6 13/16
Various.	Beira-Umtali	204	June, 1935	56,051	— 1,046	38	576,265	456,945	+ 119,320	—	—	—	—	—
	Bilbao River & Cantabrian	15	June. 1935	1,261	— 97	26	9,905	10,459	— 554	—	—	—	—	—
	Egyptian Delta	622	31.7.35	6,107	— 216	18	64,145	65,178	— 1,033	Prf. Sh.	21 3/16	13 1/4	17 3/8	5 5/16
	Great Southern of Spain ..	104	10.8.35	1,248	— 1,103	32	55,775	65,926	— 10,151	Inc. Deb.	4	3 1/2	3 1/2	Nil
	Kenya & Uganda	1,625	July, 1935	180,643	+ 18,481	30	1,473,420	1,385,090	+ 88,330	—	—	—	—	—
	Manila	—	—	—	—	—	—	—	—	B. Deb.	50	33	41	8 9/16
	Mashonaland	913	June, 1935	102,039	— 7,073	38	1,047,960	840,132	+ 207,828	1 Mg. Db.	101	91 3/4	103 1/2	4 13/16
	Midland of W. Australia ..	277	June. 1935	11,739	— 292	52	159,573	158,208	+ 1,365	Inc. Deb.	100	93	94 1/2	5 5/16
	Nigerian	1,905	29.6.35	24,202	+ 4,848	13	329,613	336,272	— 6,659	—	—	—	—	—
	Rhodesia	1,538	June, 1935	182,536	— 1,260	38	1,723,519	1,418,680	+ 304,839	4 p.c. Db.	104 7/8	97 1/2	104	3 15/16
	South African	13,217	27.7.35	544,318	+ 61,848	17	9,189,126	8,297,138	+ 891,988	—	—	—	—	—
	Victorian	4,728	Apl., 1935	799,418	+ 68,999	43	7,962,662	7,716,599	+ 246,063	—	—	—	—	—
	Zafra & Huelva	112	June, 1935	9,846	— 232	26	65,245	65,801	— 556	—	—	—	—	—

NOTE.—Yields are based on the approximate current prices and are within a fraction of 1/16

† Receipts are calculated @ 1s. 6d. to the rupee. § ex dividend. Salvador and Paraguay Central receipts are in currency

The variation in Sterling value of the Argentine paper peso has lately been so great that the method of converting the Sterling weekly receipts at the par rate of exchange has proved misleading, the amount being overestimated. The statements from July 1 onwards are based on the current rate of exchange and not on the par value.

Electric Railway Traction

British Electrification

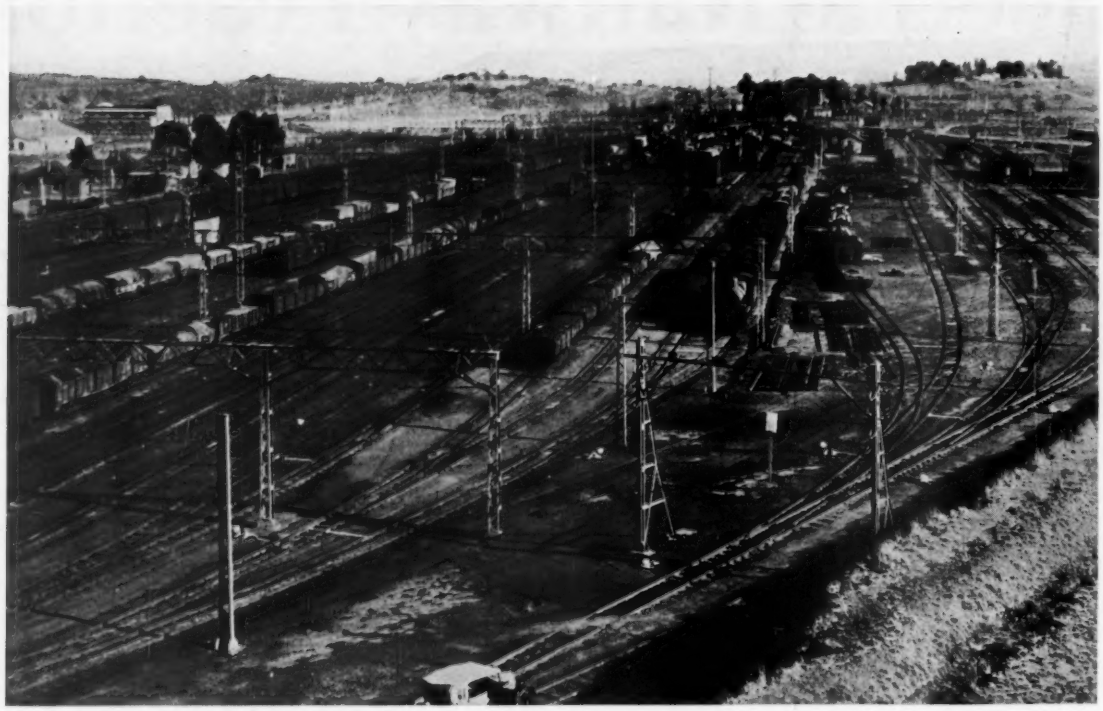
SINCE the Government announced its intention of supporting the L.N.E.R. in the electrification of certain suburban lines converging on Liverpool Street station, definite signs have been given that railway electrification in Britain is to be speeded up. The first result of the Government's decision was to stimulate electrification agitations in most of the 96 big towns of Great Britain, but without a general scheme of a magnitude approaching that discussed in the Weir report, it is obvious that most of these were foredoomed to failure. Nevertheless, there are certain cities in which the traffic problem is almost as acute as it is round the Metropolis, and it will be surprising if more Government guarantees are not forthcoming in the near future. Perhaps the most encouraging feature is that without any extraneous assistance and very little outside pressure, the L.N.E.R. has decided to electrify the 11-mile double-track suburban line along the south bank of the Tyne from Newcastle to South Shields. (See map and description in THE RAILWAY GAZETTE for August 9.) This conversion really forms an extension of the north Tyneside electrified lines, and will assist in providing an intensive user for the new rolling stock now being built. Without previous electrification in the district, it is unlikely that the South Shields line would have been converted, for the present service at 20-min. intervals, with extra trains at rush hours, is sufficient to cope with the traffic. But although the town has lost some of its former importance as a seaport, it is becoming increasingly popular as a seaside resort for day trippers, and it is probable that the faster and cleaner service which electric trains will provide will lead to an extension of its residential quarter.

It is not generally realised outside interested circles that the location of the routes has a marked effect on the efficiency and economy of electrified lines. It is for this reason that we believe that the schemes mooted for the electrification of the lines in the Wirral peninsula must await the satisfactory solution of the railway transport question between Liverpool and Birkenhead. Without the presence of Liverpool on the other side of the Mersey, the traffic on the Wirral lines would probably be meagre, and to electrify the Wirral routes without making provision for electric trains to run direct into the Liverpool termini seems to us to be solving only the easier half of the problem. Further up the Mersey, the urban and suburban problems of Manchester form probably the finest field for electric traction outside of London. The whole of the suburban routes within a 10- or 12-mile radius of the centre of that city might with profit be converted to electric traction, and there is evidence that the electrification of more than one route is now being considered with that seriousness and attention to detail which usually presages definite action. But the electrification of the south-east Lancashire lines on an extensive scale bristles with problems, principal among which are the enormous number of connecting lines, the dense goods traffic, and the number of long-distance trains running through the suburban area, all of which factors are present in a greater degree than they are in the Southern Railway electrified area south of the Thames. The fact that the Lancashire lines are owned by two companies, the L.M.S.R. and L.N.E.R., should not lead to additional complication in these days of railway co operation, but the difference between the Metropolitan and Mancunian electrified systems of the future will be in type of current used, for with the existing Manchester, South Junction & Altrincham line at 1,500 volts and the Manchester-Bury line at 1,200 volts, there can be little doubt that the high-tension principle will be used in preference to the 600-volt supply of the London lines. Another factor affecting the Manchester lines is that certain heavily-trafficked inter-urban lines come within the bounds of probable future electrification, and of these, the conversion of the L.N.E.R. Sheffield-Manchester main line is being examined once more.

In Scotland, the suburban electrification question is limited to the Glasgow lines, particularly those belonging to the L.M.S.R. Although it is proposed to carry electrification as far as the Clyde coast resorts, such as Wemyss Bay, the immediate need is for the conversion of the inner lines, roughly within the limits of Airdrie, Hamilton, Barrhead, Paisley, and Renfrew. Apart from economy and efficiency of operation, the present system of working these lines is characterised by the attribute found in a most striking degree on the Great Eastern suburban lines—namely, dirt. The elimination of the smoke and soot consequent upon the steam operation of closely-packed densely-trafficked lines through numerous tunnels and built-over areas is of itself sufficient reason for electrification, and the filthy atmosphere which abounds in numerous terminal stations would never be tolerated were it not that our financial system has not progressed with the development of applied science, and no longer reflects realities. Electrification, with its greater efficiency, constitutes an addition to the real wealth of a community, but unfortunately the monetary cost is counted not to the credit but to the debit of the community which is enriched thereby. The desirability of converting the Glasgow lines of the L.N.E.R. is less pressing than that of the L.M.S.R. only because of their less extent, for the atmosphere of Queen Street High Level and Low Level stations is Stygian to a degree, and at least one accident in Queen Street tunnel has been due solely to the smoke nuisance. Elsewhere, the electrification of the lines converging on Birmingham, and those in the Leeds and Bradford district, needs immediate consideration, but so far as inter-urban lines in the North and Midlands are concerned it is useless to hope for satisfactory conversion schemes until the British subconscious idea of nothing but multiple-unit trains is overcome, for the goods traffic is too great to permit of conversion solely for the operation of passenger trains.

ELECTRIFICATION ACTIVITY IN SOUTH AFRICA

The 3,000-volt d.c. system is being extended for main-line and suburban work



General view of Daimana yard, recently electrified on the 3,000 volts d.c. system

SINCE the description of the conversion programme and existing works of the South African Railways was published in the February 9, 1934, issue of this Supplement, a much larger programme of electrification has been decided upon, and in addition the Daimana-Harrismith section of the Natal to Orange Free State main line has been opened to electric traction.

To understand the present situation a brief recapitulation of the earlier works is advisable. After the war, Messrs. Merz & McLellan prepared two reports on the electrification of the Natal main line, first from Pietermaritzburg to Durban, and later from Glencoe through Pietermaritzburg to Durban. The Glencoe-Pietermaritzburg division was the most urgent case; its conversion was put in hand and electric operation inaugurated in 1925. The report of Messrs. Merz & McLellan also recommended the conversion of the Capetown-Simonstown suburban line: this project was shelved for financial reasons, but was taken up later, with the result that an electric service was begun in 1927 to Seapoint and in 1928 to Simonstown.

No other electrification work was undertaken until the present decade, when, largely as a result of the considerable falling off in the Transvaal-Durban coal traffic owing to trade depression, it was decided to extend electric operation from Pietermaritzburg to Cato Ridge (opened in February, 1932), and later, from Daimana junction to Harrismith. A more economical load for Colenso power station (then working at a low load factor) was thus provided; the 95 electric locomotives were used more intensively, and certain operating advantages were secured. The Daimana-Harrismith line was opened to electric traction in February, 1935, but meanwhile, in December, 1933, the Capetown electrified suburban services were extended out along the main line as far as Belleville, and in April, 1934, an alternative electric route to Simonstown was provided by the electrification of the Cape Flats line from Maitland to Dieprivier. The Capetown lines were electrified on the 1,500-volt d.c. system, and the Natal lines at 3,000 volts d.c.

Beginning with the Pietermaritzburg to Cato Ridge line in 1930-32, all conversion works have been carried out by

3,000-VOLT D.C. SECTIONS, SOUTH AFRICAN RAILWAYS.

Section	Route mileage	Track mileage	Date opened
Pietermaritzburg–Glencoe	170	287	1925
Pietermaritzburg–Cato Ridge ..	30	60	29/2/32
Daimana–Harrismith	60	71	2/2/35
Cato Ridge–Durban	45	126	U.C. (end of 1935)
Glencoe–Vryheid East	60	70	Authorised, but conversion deferred
Glencoe–Newcastle–Volksrust ..	78	90	U.C.
Rand lines	74	223	U.C. (end of 1936)

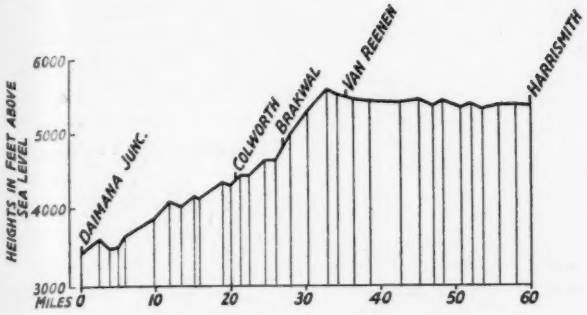
1,500-VOLT D.C. Sections

Section	Route mileage	Track mileage	Date opened
Capetown–Salt River–Simonstown ..	22·5	33	June, 1928
Salt River–Belleville	9·75	31	December, 1933
Maitland–Dieprivier	9·5	?	April, 1934

Capetown (Monument)–Seapoint line converted October, 1927, but since dismantled.

Mileage actually in operation, August, 1935:

3,000 volts .. .. 260 route
1,500 volts .. .. 41½ route



Gradient profile of Daimana-Harrismith line

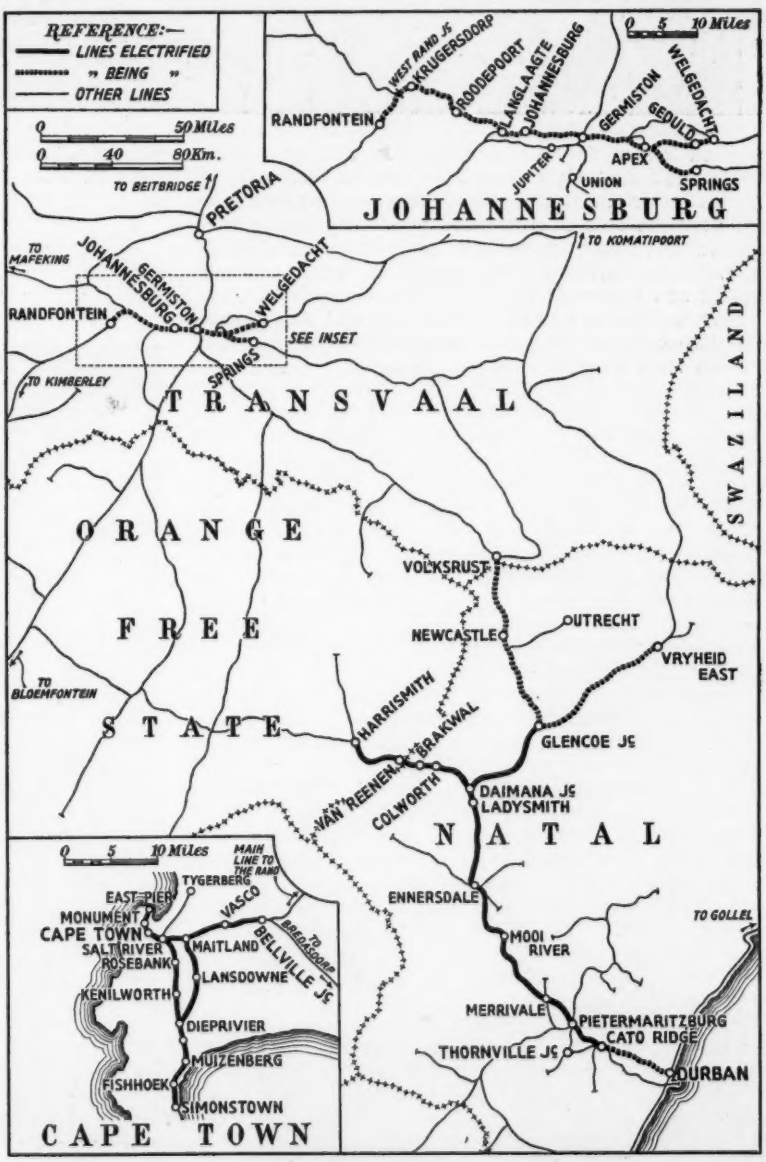
the South African Railways, the switchgear and substation plant being bought from various electrical contractors. Before the completion of the Daimana-Harrismith section it was decided, at the beginning of 1934, to extend the Natal electrification northwards from Glencoe to Newcastle (37 miles), and north-east from Glencoe to Vryheid East (60 miles). It was not found necessary to increase the locomotive stock or the power station plant to cope with these prolongations, but when, later in the same year, it was decided to electrify the line from Cato Ridge down to Durban (45 miles), further locomotives became necessary and orders for these (including two shunting locomotives for yard work) have been placed with the Metropolitan-Vickers Electrical Co. Ltd.

Towards the end of 1934, instructions were given for the prolongation to Volksrust, on the Transvaal border, of the authorised electrification from Glencoe to Newcastle; the route mileage from Newcastle to Volksrust is approximately 40. The locomotive orders now being pushed through in England include the units necessary for working this line, and also five which have become necessary to handle the traffic on the Daimana-Harrismith line.

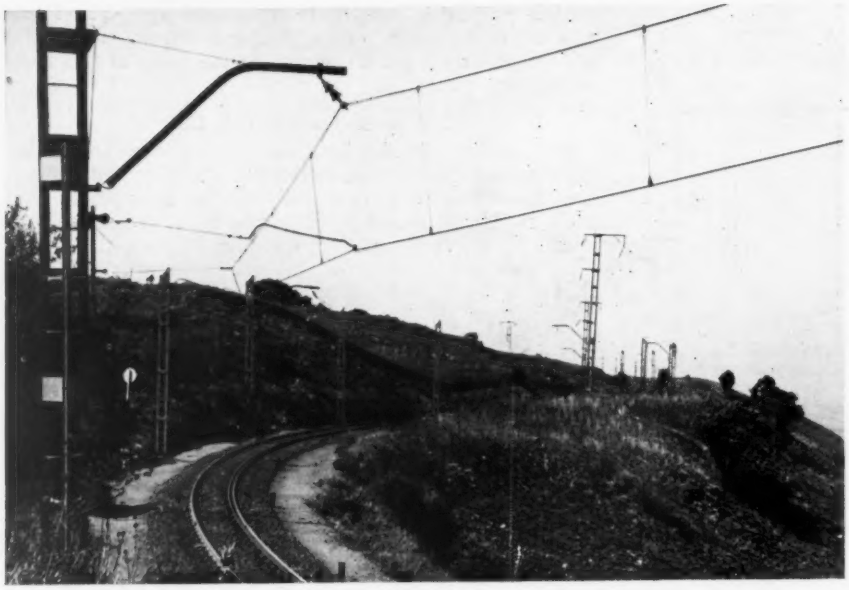
Apparently, following the decision to convert the Newcastle-Volksrust line, the Daimana-Vryheid East conversion has been deferred. The most momentous decision affecting electrification, however, is that made recently to convert a number of lines on the Rand at a cost stated to be in the neighbourhood of £1,000,000. Work has begun already on the lines from Randfontein to Springs (58 miles); Langlaagte to Orlando (6 miles); and Apex to Welgedacht via Geduld (10 miles), and the conversion will be quite different from any previously undertaken on the 3,000-volt system in South Africa, in that these 74 route miles comprise no fewer than 223 track miles and numerous junctions. Already the possibility of prolonging the electrification along the heavily-trafficked line to Witbank has been considered, and there seems little reason to doubt that eventually the Germiston-Volksrust line will be converted, thus giving a through electric run from Durban to Johannesburg. The lines now electrified or in course of conversion on the South African Railways are as shown in the table at the foot of the previous page.

Daimana-Harrismith Line

Considering its location and length, the Daimana-Harrismith section possesses exceptionally interesting traffic and technical features. In the first place, the route is steeply-graded, rising 2,236 ft. in 35 miles, and is sharply curved over the mountain division; the maximum grade is 3 per cent. and the profile of the line is shown in a condensed form in one of the accompanying illustrations. It was highly desirable that regenerative braking should be employed in view of the heavy freight and mineral trains passing down grade; in the normal way this would have necessitated the use of rotary converter sets, but a pioneer step was taken by the decision to instal reversible mercury arc rectifiers, which could



Map showing electrification works of the South African Railways



Overhead construction for 3,000-volt d.c. contact lines and 88 kV. three-phase transmission line crossing each other on a curve on the Daimana-Harrismith line of the South African Railways. The masts for both systems are fabricated from old rails electrically welded together

be used either for a.c.-d.c. or d.c.-a.c. conversion. Finally, the methods of overhead construction used by the South African Railways engineers were so simple as to reduce the cost of conversion (excluding the price of the five locomotives now being built) to approximately £180,000, or £2,550 per track mile, including two substations and a 61-mile three-phase transmission line.

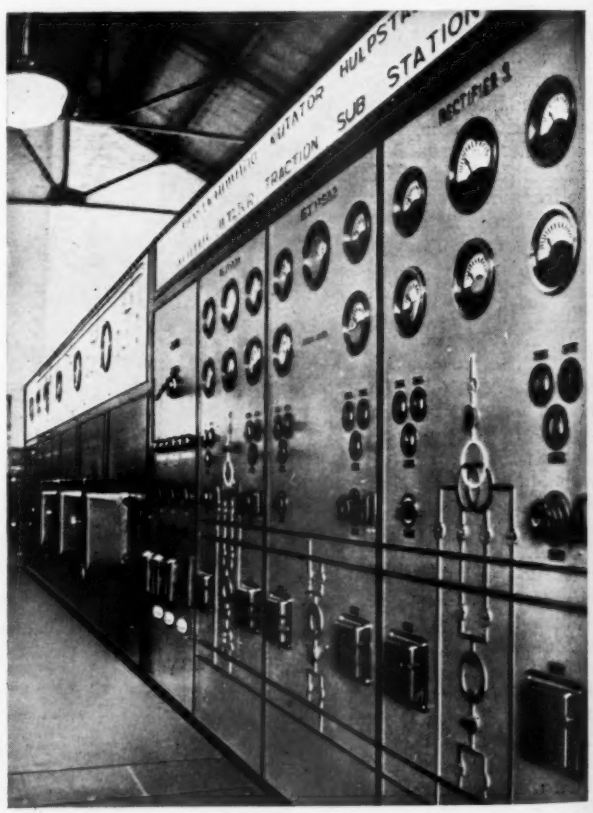
The substations are located at Colworth and Van Reenen, approximately one-third and two-thirds of the length of the line from Daimana. Each substation contains three 2,000-kW. Brown Boveri steel-tank mercury rectifiers arranged for reversible working, and termed by the builders "mutators."* The incoming energy is at 88 kV. three-phase and is obtained from a transmission line erected by the South African Railways for the Electricity Supply Commission, which organisation—following the practice on the Natal lines—also owns the substations, although the Railways operate them. There are two oil-cooled outdoor transformers to each substation, and normally one transformer is connected with two rectifiers (mutators), one of which is in a.c.-d.c. operation for feeding the track at 3,000 volts d.c., and the other in d.c.-a.c. operation for regeneration. The valve action of the mutators prevents a flow of current between them when so connected. The transformers have three windings, *viz.*, an 88-kV. primary, and two secondary windings, one for a.c.-d.c. service and the other for d.c.-a.c. The mutators have a continuous a.c.-d.c. rating of 1,500 kW. at 3,000 volts, a two-hourly rating of 1,700 kW., a one-minute load of 4,900 kW., and a momentary capacity of 5,500 kW.; when operating in regenerative service, however, that is, d.c.-a.c., the continuous load is 450 kW. The second transformer and third mutator comprise the stand-by plant. The 88-kV. outdoor switchgear of the substations was supplied by the International G.E.C. and the 3,000-volt d.c. switchgear by the British Thomson-Houston Co. Ltd.

Much of the 88-kV. transmission line was carried on the masts supporting the overhead contact wire, and the simple form of construction can be seen in some of the accompanying illustrations. All of the 3,000 odd structures were fabricated of discarded 80-lb. and 60-lb. flat-bottomed rails and flattened old steel sleepers, electrically welded to the gussets and cross braces, and set in pre-cast concrete foundations.

* See editorial comment on page 330, and description of mutator operation on page 331.

The Natal Lines

Between Cato Ridge and Durban are two sharply curved routes; the old, with grades up to 3 per cent., to the south; and the new, with 1·5 per cent. grades, to the north. It was for service over the latter that the 214-ton Beyer-



Switchboard for Brown Boveri mutators in one of the substations on the Harrismith line

Garratt articulated steam engines were built in 1930. This line has been doubled gradually during the last two or three years, and the work has included laying of the second track (to the standard South African gauge of 3 ft. 6 in.) through ten major tunnels and numerous rock cuttings, and over high embankments. It is only recently that this doubling has been completed, but for the past year electrification work has been proceeding over those portions having two tracks, and it is expected that the conversion will be finished by the end of this year.

The 88-kV. line which is being erected by the Railways on behalf of the Electricity Supply Commission, is being laid along the route of the old line from Pietermaritzburg through Thornville junction to Cato Ridge, and thence along the tops of the contact wire masts as far as Booth junction, near Durban. The estimated conversion cost of the Cato Ridge-Durban section (including the entirely separate transmission line over the first part of the route) is £390,000, made up as follows:—

	£
Expenditure by Railways—	
Line equipment and track alterations	130,000
13 new electric locomotives	130,000
	260,000
Expenditure by Electricity Supply Commission—	
88-kV. transmission line	60,000
Five rectifier substations	70,000
	130,000
Grand total	390,000

It is claimed that the greater part of the £260,000 to be spent by the Railways will be offset by the value of the 31 eight-coupled locomotives which will be released for service elsewhere; the total value of these units is being written down as £223,600. The direct saving in working by the substitution of electric for steam operation has been calculated at £41,400 a year, but of course there are various indirect advantages to which it is difficult to attach a definite figure.

On the Glencoe-Volksrust section the anticipated direct saving in operation by the adoption of electric traction is £32,300 a year. Here again the value of the 28 replaced steam engines is shown in the accounts at a figure which nearly balances the Railways' portion of the cost of conversion—£205,441 against £220,000. The estimated cost of converting the 78 route and 88 track miles of this division is £328,000, made up as follows:—

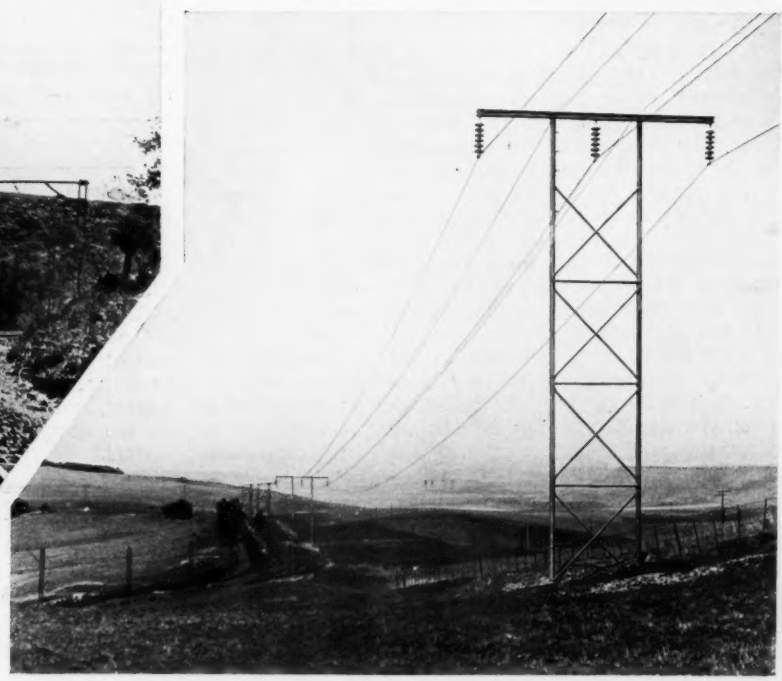
	£
Expenditure by the Railways—	
Line equipment, telegraph and telephone alterations	120,000
Ten new electric locomotives	100,000
	220,000
Expenditure by the Electricity Supply Commission—	
Transmission line (71 miles)	36,000
Six substations	72,000
	108,000
Grand total	328,000

Extensive track alterations are being made between Newcastle and Volksrust (at a cost additional to that shown above), and these must be finished before electrification work can begin on the sections affected; it is not expected that the conversion will be completed before the beginning of 1937. The 88-kV. transmission line is being run along the tops of the overhead masts wherever practicable. It is for operation on these various Natal lines that the British Thomson-Houston Co. Ltd. has received an important order for mutators and switchgear, recorded in THE RAILWAY GAZETTE for April 12, 1935.

The Witwatersrand

The lines round Johannesburg now in course of electrification are shown in the accompanying map. Despite the heavy mineral traffic in the district, only the shorter distance passenger trains will be electrically-operated at first. The sum of £1,000,000 provisionally voted for the

Above: Overhead construction on a curve, South African Railways



Right: 88 kV. transmission line joining 3,000-volt d.c. electric railway

conversion does not include the cost of the 72 electric motor-coaches required or the electrical repair depot which is to be laid down at Braamfontein, the combined cost of which will exceed £500,000. It is probable that the building of the bodies for the steel motor-coaches and the erection of the electrical equipment in them will be carried out in the shops of the South African Railways. The preliminary designs show 27 of these to be first class, 12 third class, and the remainder composites. In general, they will be 60 ft. long and 9 ft. wide. Trailers to the number of 128 are being converted from steam-hauled stock.

Overhead construction similar to that used on the Daimana-Harrismith section is to be erected, and the 4,000-odd welded steel masts needed are now being fabricated from old rails in a special shop laid down at Germiston. The tracks to be electrified include a double line from Randfontein to Langlaagte and a four-track stretch thence through Johannesburg to Germiston. Contemplated track alterations may result in a quintuple track being converted.

A separate e.h.t. transmission line will not be required, as a supply of power at 40 kV. three-phase is available from the network of the Victoria Falls Power Company. Eight substations spaced along the 74 miles of route will convert this supply to 3,000 volts d.c., which system is being used in preference to the 1,500 volts tension of the Capetown suburban tracks because of future main line workings. These substations will be of the rectifier type; four of them will be single unit, three double unit, and one triple unit. A point emphasised in the specifications is that interference with adjacent telegraph, telephone, and radio circuits must be eliminated.

Civil engineering works include the straightening of several sections of line in the western Rand so that higher speeds may be attained with safety; it is anticipated that subsidences in the thick of the mining area may cause trouble, and very careful attention is now being given to this question. Opportunity is being taken to instal colour-light signalling along the whole of the Rand, but at the moment it is not known whether this will be of the manual or automatic type.

Capetown Suburban Traffic

It cannot be said that the suburban traffic of Capetown has been a really paying proposition since the war, either in steam days or since electrification. For some years there has been a deficit on the Capetown-Simonstown and Cape Flats lines, and although electrification has not wiped out the losses they are gradually being reduced. In 1933-34 the loss of £127,231 on the Simonstown line was over £25,000 less than in the previous year. Despite severe competition from the road, traffic on the Cape Flats line has increased slowly since electrification, mainly by reason of the 30 per cent. cut in the times between Capetown and the stations at the southern end of the line. The Salt River-Belleville line was electrified at a cost of only £30,000, although the saving in operation is expected to amount to nearly £15,000 a year, and the reduction of 25 per cent. in the schedules has resulted in a considerable increase in passenger traffic. Westinghouse automatic and semi-automatic colour-light signals were installed on the Salt River-Belleville section at the time of electrification.

Power Consumption and Traffic

Following the general improvement in traffic, the current supplied for traction purposes by Colenso and Salt River power stations during the fiscal year 1933-34 increased by 9·5 per cent. to 124,173,127 units, but the current cost increased only by 1 per cent. to £418,880. The inclusive cost per unit paid for current fell by 8·2 per cent. to 0·7671d. for the production of Colenso, and by 7·2 per cent. to 0·9233d. for the output of Salt River. This reduction followed the increased consumption. Over the Natal main line south of Ladysmith the traffic in 1933-34 increased by 3·9 per cent. to 4,994,593 tons, or from 15,300 to 15,900 tons a day. The capacity of this section, however, is nearly 40,000 tons a day.

Rectifier or Mutator?

SINCE the mercury arc rectifier was developed to such a degree that by the insertion of grid control it could be used either for a.c.-d.c. or d.c.-a.c. conversion, the term "rectifier" has lost its true significance of "rectifying" alternating into direct current. Moreover, other developments have led to the production of similar apparatus for converting three-phase to single-phase current of another frequency, and on the Continent these various types of similar machines apparently have led to some confusion in the use of correct terms. Up to the present we ourselves have not met with much difficulty in this direction, and have used simply the terms rectifier, inverted rectifier, and phase converter. Admittedly, such terms are not directly translatable into other languages, the equivalents in German being *Stromrichter, Wechselsrichter,* and *Umrichter;* and in French, *redresseur, dévertisseur,* and *convertisseur de fréquence.* But as the grid-controlled rectifier can be used for any kind of conversion, Brown-Boveri suggests that the generic term "mutator," from the Latin *mutare* (to alter, or transform), should be used in conjunction with the type of conversion; that is, a.c.-d.c. mutator for a rectifier; d.c.-a.c. mutator for an inverted rectifier, and so on. It seems logical to have a common term which indicates immediately that the apparatus is on a certain principle, but at the moment we have an open mind about the Brown-Boveri suggestions. However, the use and introduction of Brown-Boveri and B.T.H. inverted rectifiers on the Italian State and South African Railways (as described elsewhere in this issue) necessitates the matter being brought to a head as far as traction applications are concerned. Brown-Boveri suggests the terms in the following table:—

Old Designation	Proposed Designation
Rectifier	A.C.-D.C. Mutator
Inverted Rectifier	D.C.-A.C. Mutator
Frequency Changer	A.C.-A.C. Mutator
3-phase–3-phase converter	3-phase–3-phase Mutator
3-phase–1-phase converter	3-phase–1-phase Mutator

At the moment we are inclined to think that, so far as the English language is concerned, the proposed terms are no better than the old, but there remains the question of possible standard words which would be the same in all languages, or else terms which are easily translatable, and we would welcome the opinions of our readers on the designation to be given the above types of converters.

FURTHER TYNESIDE ELECTRIFICATION.—The L.N.E.R. has decided to electrify on the 600-volt d.c. system, the 11-mile double track line between Newcastle Central and South Shields. A map of this line, together with a description of the electrical equipment and rolling stock, will be found in THE RAILWAY GAZETTE of August 9.

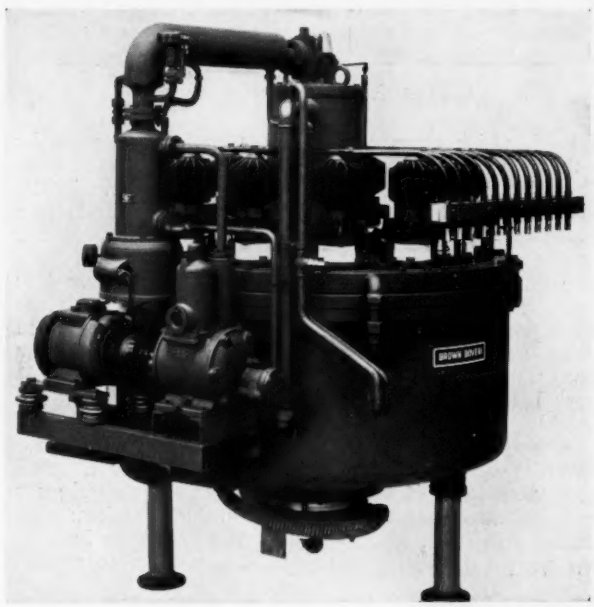
RECTIFIERS FOR REGENERATION

Recent practice in Italy and South Africa permits of regeneration on d.c. lines by means of grid-controlled inverted operation

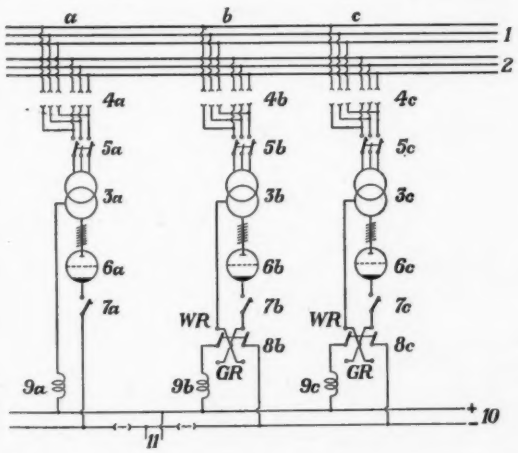
PRACTICALLY the only defect of the mercury arc rectifier for traction service has been that when installed over routes having heavy grades it was not feasible to use regenerative braking. If the regenerated current could always have been used directly by trains going uphill all would have been well, but it is essential that provision be made for returning regenerated current into the e.h.t. transmission system during periods of light load, and for this reason rotary converter sets were used on such railways. By the application of grid control, it is now possible for a rectifier to be reversed in its action and convert d.c. into a.c. by reversing the voltage and making a corresponding displacement in the anode ignition point. Rectifiers of this type designed and built by Brown-Boveri were installed in the San Viola substation of the Bologna-Florence Direttissima in 1934 and in the Cava dei Tirreni substation of the Naples-Salerno line in 1935. Similar units were also brought into use in the Colworth and Van Reenen substations of the Daimana-Harrismith section of the South African Railways in 1935, shortly after the opening of that division in February.

The usual substation arrangement comprises one or more rectifiers—according to the output—working continuously in conjunction with inverted rectifiers. For instance, in the South African substations, one rectifier and one inverted rectifier are operated together from one transformer, the third rectifier (which can be operated a.c.-d.c. or d.c.-a.c. as required) and the second transformer being spares. In the San Viola substation on the Direttissima line of the Italian State Railways the principal feature is that two independent three-phase 50-cycle low voltage supplies are led in, and the contact line must (*a*) be fed from either or both of these as required, and (*b*) also feed back regenerated current to either system while being supplied from the other. In order that the power exchange shall not be subject to the effect of accidental voltage fluctuations, high-speed circuit breakers are used to limit the energy which can be transferred. Main wiring diagrams of both the Italian and South African substations are given on this page.

The following notes on inverted rectifiers and their operation have been obtained in the main from Brown-

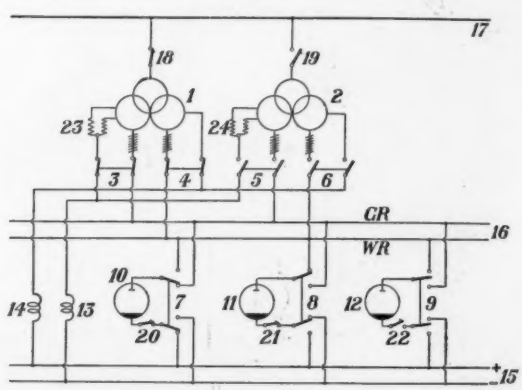


Grid-controlled rectifier suitable for a.c.-d.c. or d.c.-a.c. operation as used on the 3,000-volt d.c. lines of the Italian State Railways



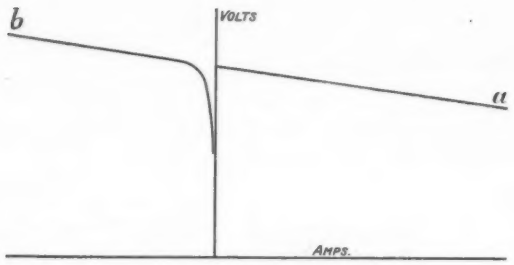
a.—Rectifier set apparatus.
b, c.—Reversible rectifier set apparatus
1, 2.—Three-phase systems of different frequencies.
3.—Transformer.
4.—Disconnecting links
5.—Oil circuit breaker.
6.—Rectifier.
7.—High-speed circuit breaker.
8.—Change-over switch.
9.—Choke coil.
10.—D.C. busbars.
11.—Leads to feeder switches.

Main wiring diagram of S. Viola substation, Italian State Railways



1, 2.—Transformers.
3, 4, 5, 6.—Disconnecting links.
7, 8, 9.—Change-over switch.
10, 11, 12.—Rectifier units.
13, 14.—Choke coils.
15.—D.C. busbars.
16.—Auxiliary busbars.
17.—Three-phase supply.
18, 19.—Oil circuit breakers.
20, 21, 22.—High-speed circuit breakers.
23, 24.—Interphase transformers.

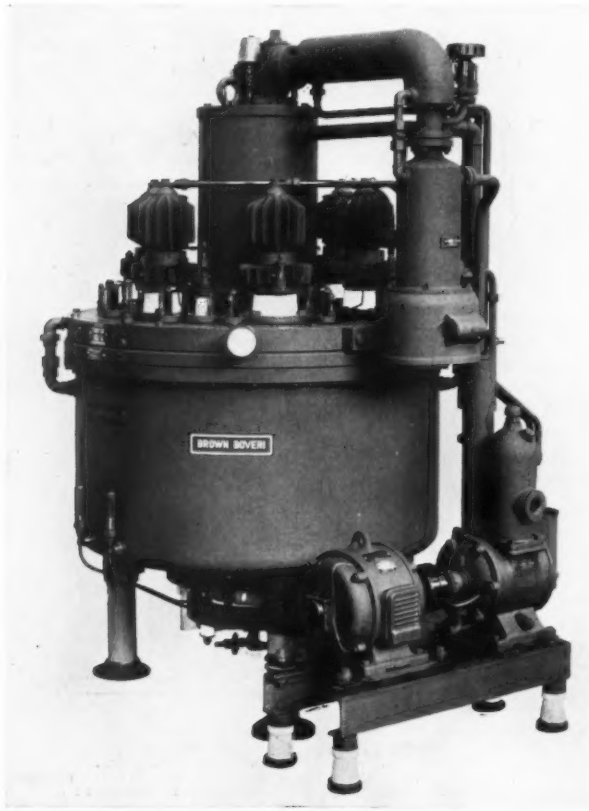
Main wiring diagram of Van Reenen and Colworth substations, South African Railways



Characteristics of inverted rectifier

Boveri, which company, so far as we are aware, is the only manufacturer having in actual railway service rectifiers of this type. The straight line *a* in the characteristic curves reproduced at the head of this column is the voltage curve of the rectifier as a function of the load current, on the assumption that the voltage of the primary supply and the anode ignition point are fixed. The curve *b* is the voltage characteristic of an inverted rectifier, with the same provisos as before. The d.c. voltage of the inverted rectifier rises as the current increases, because the voltage drop starting from the d.c. side must be compensated. At very light loads the grid control causes curve *b* to fail quickly.

A suitable choice of the anode ignition point for inverted operation gives the inverted rectifier a small continuous load, which keeps the anodes and control grids hot, and thus assists reliable operation during sudden peak loads. This small load represents practically no loss, as the energy is restored to the primary supply. In regenerative systems, a suitable choice of the anode ignition point of the inverted rectifier fixes the characteristic of the last-named so that regeneration begins when the voltage of the system exceeds the no-load voltage.



1,500 *kW. Brown-Boveri rectifier suitable for a.c.-d.c. or d.c.-a.c. operation, South African Railways*

Italian Installation

In the San Viola substation of the Italian State Railways there are three 2,000-kW. rectifier sets, *a*, *b*, and *c* (see wiring diagram on previous page); two of these are capable of inverted operation, but the third can be used only as a rectifier. The transformers *3a, 3b, 3c* can be connected to either of the two three-phase supplies through the disconnecting links *4a, 4b, 4c*. According to whether the set in question is to work as a rectifier or inverted rectifier, the sets *b* and *c* can be connected with different polarities to the d.c. busbars by means of the change-over switches *8b* and *8c*. Auxiliary contacts on these switches effect the necessary changes in the grid circuits. The control of the grids is by means of a synchronous contact maker which imparts to the anode grids the positive voltage impulses which ignite the anodes. A small motor-generator set provides the necessary d.c. voltage for the grid control.

Sets *b* and *c* (capable of inverted operation) are equipped with automatic load regulators, but set *a* is not so controlled. All three sets have short-circuit protection through the agency of the controlled grids, and this protection consists of a quick-acting relay actuated by the primary current of the main transformer, and which, whenever a short circuit occurs, connects up all the grids to a voltage which is negative compared to the cathode. This blocks the passage of the d.c. in the rectifier. With inverted operation, a short circuit on the three-phase side results in a short circuit on the d.c. side because of there being no counter voltage in the transformer. A short circuit of this nature cannot be dealt with by grid control, but is suppressed almost instantaneously by the high-speed breakers *7a*, *7b*, or *7c*.

For a given d.c. voltage, the secondary phase voltage of the transformer must be greater for inverted operation than for a straight rectifier, and the primary windings of the transformers are provided with tappings to allow of adjusting the secondary phase voltages to suit the particular service conditions.

South African Practice

In the Van Reenen and Colworth substations of the South African Railways, the rectifier and inverted rectifier are supplied normally from one transformer, which has a primary winding for the 88-kV. three-phase supply; a secondary winding for the rectifier (corresponding to 3,000 volts d.c.) when used with an interphase transformer; and a third winding for the inverted rectifier without an interphase transformer. The breaker positions shown in the wiring diagram on the previous page correspond to standard operation. Set 10 operates as a rectifier; its anodes are connected to the busbar 16 GR and its cathode to the positive d.c. busbar 15. Set 11 operates as an inverted rectifier, with its anodes connected to the busbar 16 WR and its cathode to the negative d.c. busbar 15.

Both sets are connected to transformer 1; transformer 2 and rectifier 12 (capable of either way operation) act as spares. When the d.c. system is heavily loaded the spare set 12 can be used with transformer 2, and further, the inverted rectifier may be reversed. The arrangement of the auxiliary busbars allows of numerous connections between the different transforming and converting elements. The rectifiers are equipped with voltage regulation for flat compounding of their characteristics. Short circuit protection is on similar lines to that installed in the San Viola substation in Italy.